

# **UNIFORM BUILDING CODE**

***1955 Edition***

***Volume I***



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# *Preface*

¶ The Uniform Building Code is dedicated to the development of better building construction and greater safety to the public, through the elimination of needless red tape, favoritism, and local politics by uniformity in building laws; to the granting of full justice to all building materials on the fair basis of the true merits of each material; and to the development of a sound economic basis for the future growth of cities through unbiased and equitable dealing with structural design and fire hazards.



## ***The Uniform Building Code***

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**Pacific Coast Building Officials  
Conference**

**UNIFORM BUILDING CODE**

**Ordinance No.....**

An ordinance regulating the erection, construction, enlargement, alteration, repair, moving, removal, conversion, demolition, occupancy, equipment, use, height, area, and maintenance of buildings or structures in the City of

.....;  
providing for the issuance of permits and collection of fees therefor; declaring and establishing Fire Districts; providing penalties for the violation thereof, and repealing all ordinances and parts of ordinances in conflict therewith.

Be it ordained by the.....

of the City of.....as follows:

## PART I

### ADMINISTRATIVE

#### CHAPTER 1—TITLE AND SCOPE

**Sec. 101.** This ordinance shall be known as the "Building Code," may be cited as such, and will be referred to herein as "this Code." **Title**

**Sec. 102.** The purpose of this Code is to provide minimum standards to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location and maintenance of all buildings and structures within the city and certain equipment specifically regulated herein. **Purpose**

Wherever in this Code reference is made to the Appendix, the provisions in the Appendix shall not apply unless specifically adopted.

**Sec. 103.** The provisions of this Code shall apply to the construction, alteration, moving, demolition, repair, and use of any building or structure within the city, except work located primarily in a public way, public utility towers and poles, mechanical equipment not specifically regulated in this Code, and hydraulic flood control structures. **Scope**

Additions, alterations, repairs, and changes of use or occupancy in all buildings and structures shall comply with the provisions for new buildings and structures except as otherwise provided in Sections 104, 306, and 502 of this Code.

Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

**Sec. 104. (a) General.** Buildings or structures to which additions, alterations, or repairs are made shall comply with all the requirements for new buildings or structures except as specifically provided in this Section. **Application to Existing Buildings**

For construction in Fire Zones see Chapter 16.

**(b) Additions, Alterations, and Repairs: More than 50 Per Cent.** When additions, alterations, or repairs within any 12-month period exceed 50 per cent of the value of an existing building or structure, such building or structure shall be made to conform to the requirements for new buildings or structures.

**(c) Additions, Alterations, and Repairs: 25 to 50 Per Cent.** Additions, alterations, and repairs exceeding 25 per cent but not exceeding 50 per cent of the value of an existing building or structure and complying with the requirements for new buildings or structures may be made to such building or structure within any 12-month period without making the entire building or structure comply. The new construction

**Application  
to Existing  
Buildings  
(Cont'd.)**

shall conform to the requirements of this Code for a new building of like area, height, and occupancy. Such building or structure, including new additions, shall not exceed the areas and heights specified in this Code.

(d) **Additions, Alterations, and Repairs: 25 Per Cent or Less.** Structural additions, alterations, and repairs to any portion of an existing building or structure, within any 12-month period, not exceeding 25 per cent of the value of the building or structure shall comply with all of the requirements for new buildings or structures, except that minor structural additions, alterations, or repairs, when approved by the Building Official, may be made with the same material of which the building or structure is constructed. Such building or structure, including new additions, shall not exceed the areas and heights specified in this Code.

(e) **Non-Structural Alterations and Repairs: 25 Per Cent or Less.** Alterations or repairs, not exceeding 25 per cent of the value of an existing building or structure, which are non-structural and do not affect any member or part of the building or structure having required fire resistance, may be made with the same materials of which the building or structure is constructed.

(f) **Repairs: Roof Covering.** Not more than 25 per cent of the roof covering of any building or structure shall be replaced in any 12-month period unless the new roof covering is made to conform to the requirements of this Code for new buildings or structures.

(g) **Existing Occupancy.** Buildings in existence at the time of the passage of this Code may have their existing use or occupancy continued, if such use or occupancy was legal at the time of the passage of this Code, provided such continued use is not dangerous to life.

Any change in the use or occupancy of any existing building or structure shall comply with the provisions of Sections 306 and 502.

(h) **Moved Buildings.** Buildings or structures moved into or within the city shall comply with the provisions of this Code. See Section 1601 (c) for requirements in Fire Zones.

(i) **Maintenance.** All buildings or structures both existing and new, and all parts thereof, shall be maintained in a safe and sanitary condition. All devices or safeguards which are required by this Code in a building or structure when erected, altered, or repaired, shall be maintained in good working order. The owner or his designated agent shall be responsible for the maintenance of buildings and structures.

**Alternate  
Materials and  
Methods of  
Construction**

**Sec. 105.** The provisions of this Code are not intended to prevent the use of any material or method of construction not specifically prescribed by this Code, provided any such alternate has been approved.



The Building Official may approve any such alternate provided he finds that the proposed design is satisfactory and complies with the provisions of Chapter 23, and that the material, method, or work offered is, for the purpose intended, at least the equivalent of that prescribed in this Code in quality, strength, effectiveness, fire resistance, durability, and safety.

**Alternate  
Materials and  
Methods of  
Construction  
(Cont'd.)**

The Building Official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use.

**Sec. 106.** Whenever there is insufficient evidence of compliance with the provisions of this Code or evidence that any material or any construction does not conform to the requirements of this Code, or in order to substantiate claims for alternate materials or methods of construction, the Building Official may require tests as proof of compliance to be made at the expense of the owner or his agent by an approved agency.

**Tests**

Test methods shall be as specified by this Code for the material in question. If there are no appropriate test methods specified in this Code, the Building Official shall determine the test procedure.

Copies of the results of all such tests shall be retained for a period of not less than two years after the acceptance of the structure.

## CHAPTER 2—ORGANIZATION AND ENFORCEMENT

### Creation of Department

Sec. 201. There is hereby established in the city the "Building Department" which shall be under the jurisdiction of the Building Official designated by the appointing authority.

### Powers and Duties of Building Official

Sec. 202. (a) **General.** The Building Official is hereby authorized and directed to enforce all the provisions of this Code. For such purpose he shall have the powers of a police officer.

The determination of value or valuation under any of the provisions of this Code shall be made by the Building Official.

(b) **Deputies.** In accordance with the procedure and with the approval of the chief appointing authority of the municipality, the Building Official may appoint such number of officers, inspectors and assistants, and other employees as shall be authorized from time to time. He may deputize such employees as may be necessary to carry out the functions of the Building Department.

(e) **Reports and Records.** The Building Official shall submit a report to the proper city official not less than once a year, covering the work of the department during the preceding period. He shall incorporate in said report a summary of his recommendations as to desirable amendments to this Code.

The Building Official shall keep a permanent, accurate account of all fees and other moneys collected and received under this Code, the names of the persons upon whose account the same were paid, the date and amount thereof, together with the location of the building or premises to which they relate.

(d) **Right of Entry.** Upon presentation of proper credentials the Building Official or his duly authorized representatives may enter at reasonable times any building, structure, or premises in the city to perform any duty imposed upon him by this Code.

(e) **Stop Orders.** Whenever any building work is being done contrary to the provisions of this Code, the Building Official may order the work stopped by notice in writing served on any persons engaged in the doing or causing such work to be done, and any such persons shall forthwith stop such work until authorized by the Building Official to proceed with the work.

### Unsafe Buildings

Sec. 203. (a) **General.** All buildings or structures which are structurally unsafe or not provided with adequate egress, or which constitute a fire hazard, or are otherwise dangerous to human life, or which in relation to existing use constitute a hazard to safety or health, or public welfare, by reason of inadequate maintenance, dilapidation, obsolescence, or abandonment, as specified in this Code or any other effective ordinance, are, for the purpose of this Section,

unsafe buildings. All such unsafe buildings are hereby declared to be public nuisances and shall be abated by repair, rehabilitation, demolition, or removal in accordance with the procedure specified in Subsections (b), (c), (d), and (e) of this Section.

**Unsafe  
Buildings  
(Cont'd.)**

(b) **Notice to Owner.** The Building Official shall examine or cause to be examined every building or structure or portion thereof reported as dangerous or damaged and, if such is found to be an unsafe building as defined in this Section, the Building Official shall give to the owner of such building or structure written notice stating the defects thereof. This notice may require the owner or person in charge of the building or premises, within 48 hours, to commence either the required repairs or improvements or demolition and removal of the building or structure or portions thereof, and all such work shall be completed within 90 days from date of notice, unless otherwise stipulated by the Building Official. If necessary, such notice shall also require the building, structure, or portion thereof to be vacated forthwith and not reoccupied until the required repairs and improvements are completed, inspected, and approved by the Building Official.

Proper service of such notice shall be by personal service upon the owner of record, if he shall be found within the city limits. If he is not found within the city limits such service may be made upon said owner by registered mail; provided, that if such notice is by registered mail, the designated period within which said owner or person in charge is required to comply with the order of the Building Official shall begin as of the date he receives such notice.

(c) **Posting of Signs.** The Building Official shall cause to be posted at each entrance to such building a notice to read: "DO NOT ENTER. UNSAFE TO OCCUPY. Building Department, City of....." Such notice shall remain posted until the required repairs, demolition, or removal are completed. Such notice shall not be removed without written permission of the Building Official and no person shall enter the building except for the purpose of making the required repairs or of demolishing the building.

(d) **Right to Demolish.** In case the owner shall fail, neglect, or refuse to comply with the notice to repair, rehabilitate, or to demolish and remove said building or structure or portion thereof, the City Council may order the owner of the building prosecuted as a violator of the provisions of this Code and may order the Building Official to proceed with the work specified in such notice. A statement of the cost of such work shall be transmitted to the City Council, who shall cause the same to be paid and levied as a special assessment against the property.

(e) **Costs.** Costs incurred under Subsection (d) shall be paid out of the City Treasury. Such costs shall be charged to the owner of the premises involved as a special assess-

ment on the land on which the building or structure is located, and shall be collected in the manner provided for special assessments.

**Board of Appeals**

Sec. 204. In order to determine the suitability of alternate materials and types of construction and to provide for reasonable interpretations of the provisions of this Code, there shall be and is hereby created a Board of Appeals, consisting of five members who are qualified by experience and training to pass upon matters pertaining to building construction. The Building Official shall be an ex-officio member and shall act as Secretary of the Board. The Board of Appeals shall be appointed by the Mayor and shall hold office at his pleasure. The Board shall adopt reasonable rules and regulations for conducting its investigations and shall render all decisions and findings in writing to the Building Official with a duplicate copy to the appellant and may recommend to the City Council such new legislation as is consistent therewith.

**Violations and Penalties**

Sec. 205. It shall be unlawful for any person, firm, or corporation to erect, construct, enlarge, alter, repair, move, improve, remove, convert or demolish, equip, use, occupy, or maintain any building or structure in the city, or cause the same to be done, contrary to or in violation of any of the provisions of this Code.

Any person, firm, or corporation violating any of the provisions of this Code shall be deemed guilty of a misdemeanor, and each such person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this Code is committed, continued, or permitted, and upon conviction of any such violation such person shall be punishable by a fine of not more than \$300, or by imprisonment for not more than 90 days, or by both such fine and imprisonment.

## CHAPTER 3—PERMITS AND INSPECTIONS

**Sec. 301. (a) Permits Required.** No person, firm, or corporation shall erect, construct, enlarge, alter, repair, move, improve, remove, convert, or demolish any building or structure in the city, or cause the same to be done, without first obtaining a separate building permit for each such building or structure from the Building Official. **Application for Permits**

**(b) Application.** To obtain a permit the applicant shall first file an application therefor in writing on a form furnished for that purpose. Every such application shall:

1. Identify and describe the work to be covered by the permit for which application is made;
2. Describe the land on which the proposed work is to be done, by lot, block, tract, and house and street address, or similar description that will readily identify and definitely locate the proposed building or work;
3. Show the use or occupancy of all parts of the building;
4. Be accompanied by plans and specifications as required in Subsection (c) of this Section;
5. State the valuation of the proposed work;
6. Be signed by the permittee, or his authorized agent, who may be required to submit evidence to indicate such authority;
7. Give such other information as reasonably may be required by the Building Official.

**(c) Plans and Specifications.** With each application for a building permit, and when required by the Building Official for enforcement of any provisions of this Code, two sets of plans and specifications shall be submitted.

**EXCEPTIONS:** When authorized by the Building Official plans and specifications need not be submitted for the following:

1. One-story buildings of Type V conventional wood-stud construction with an area not exceeding 600 square feet;
2. Group J, Division 1, occupancies of Type V conventional wood-stud construction;
3. Small and unimportant work.

**(d) Information on Plans and Specifications.** Plans and specifications shall be drawn to scale upon substantial paper or cloth and shall be of sufficient clarity to indicate the nature and extent of the work proposed and show in detail that it will conform to the provisions of this Code and all relevant laws, ordinances, rules, and regulations. The first sheet of each set of plans shall give the house and street address of the work and the name and address of the owner and person who prepared them. Plans shall include a plot plan showing the location of the proposed building and of

**Application  
for Permits  
(Cont'd.)**

every existing building on the property. In lieu of detailed specifications, the Building Official may approve references on the plans to a specific section or part of this Code or other ordinances or laws.

Computations, stress diagrams, and other data sufficient to show the correctness of the plans, shall be submitted when required by the Building Official.

**Building  
Permits**

**Sec. 302. (a) Issuance.** The application, plans, and specifications filed by an applicant for a permit shall be checked by the Building Official. Such plans may be reviewed by other departments of the city to check compliance with the laws and ordinances under their jurisdiction. If the Building Official is satisfied that the work described in an application for permit and the plans filed therewith conform to the requirements of this Code and other pertinent laws and ordinances, and that the fee specified in Section 303 (a) has been paid, he shall issue a permit therefor to the applicant.

When the Building Official issues the permit, he shall endorse in writing or stamp on both sets of plans and specifications "APPROVED." Such approved plans and specifications shall not be changed, modified, or altered without authorization from the Building Official, and all work shall be done in accordance with the approved plans.

**(b) Retention of Plans.** One set of approved plans, specifications, and computations shall be retained by the Building Official for a period of not less than 90 days from date of completion of the work covered therein, and one set of approved plans and specifications shall be returned to the applicant, which set shall be kept on such building or work at all time during which the work authorized thereby is in progress.

Plans, submitted for checking, for which no permit is issued, and on which no action is taken by the applicant for 90 days, shall be returned to the last known address of the applicant; to renew action on said plans, a payment of a new plan-check fee shall be required.

**(c) Validity.** The issuance or granting of a permit or approval of plans and specifications shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of this Code. No permit presuming to give authority to violate or cancel the provisions of this Code shall be valid, except in so far as the work or use which it authorizes is lawful.

The issuance of a permit based upon plans and specifications shall not prevent the Building Official from thereafter requiring the correction of errors in said plans and specifications or from preventing building operations being carried on thereunder when in violation of this Code or of any other ordinance of the city.

**(d) Expiration.** Every permit issued by the Building Official under the provisions of this Code shall expire by limitation and become null and void, if the building or work

authorized by such permit is not commenced within 60 days from the date of such permit, or if the building or work authorized by such permit is suspended or abandoned at any time after the work is commenced for a period of 60 days. Before such work can be recommenced a new permit shall be first obtained so to do, and the fee therefor shall be one-half the amount required for a new permit for such work, provided no changes have been made or will be made in the original plans and specifications for such work; and provided, further, that such suspension or abandonment has not exceeded one year.

**Building  
Permits  
(Cont'd.)**

(e) **Suspension or Revocation.** The Building Official may, in writing, suspend or revoke a permit issued under provisions of this Code whenever the permit is issued in error or on the basis of incorrect information supplied, or in violation of any ordinance or regulation or any of the provisions of this Code.

**Sec. 303. (a) Building Permit Fees.** A fee for each building permit shall be paid to the Building Official as set forth in Table No. 3-A. **Fees**

Where work for which a permit is required by this Code is started or proceeded with prior to obtaining said permit, the fees above specified shall be doubled, but the payment of such double fee shall not relieve any persons from fully complying with the requirements of this Code in the execution of the work nor from any other penalties prescribed herein.

(b) **Plan-Checking Fees.** When the valuation of the proposed construction exceeds one thousand dollars (\$1,000.00) and a plan is required to be submitted by Subsection (c) of Section 301, a plan-checking fee shall be paid to the Building Official at the time of submitting plans and specifications for checking. Said plan-checking fee shall be equal to one-half of the building permit fee as set forth in Table No. 3-A.

**Sec. 304. (a) General.** All construction or work for which a permit is required shall be subject to inspection by the Building Official, and certain types of construction shall have continuous inspection by special inspectors, as specified in Section 305. **Inspections**

**TABLE NO. 3-A—BUILDING PERMIT FEES**

| TOTAL VALUATION  | FEE    |
|--|--------|
| Less than \$20.00 .....  | No Fee |
| \$20.00, to and including \$100.00 .....                                   | \$1.00 |
| More than \$100.00, to and including \$400.00 .....                        | 2.00   |
| More than \$400.00, to and including \$700.00 .....                        | 4.00   |
| More than \$700.00, to and including \$1,000.00 .....                      | 6.00   |
| Each additional \$1,000.00 or fraction, to and including \$15,000.00 ..... | 2.00   |
| Each additional \$1,000.00 or fraction, to and including \$50,000.00 ..... | 1.00   |
| Each additional \$1,000.00 or fraction exceeding \$50,000.00 .....         | 0.50   |

**Inspections  
(Cont'd.)**

(b) **Inspection Record Card.** Work requiring a building permit shall not be commenced until the permit holder or his agent shall have posted an inspection record card in a conspicuous place on the front premises and in such position as to allow the Building Official conveniently to make the required entries thereon regarding inspection of the work. This card shall be maintained in such position by the permit holder until the Certificate of Occupancy has been issued.

(c) **Approvals Required.** No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the Building Official. Such written approval shall be given only after an inspection shall have been made of each successive step in the construction as indicated by each of the inspections required in Subsection (d).

There shall be a final inspection and approval on all buildings when completed and ready for occupancy.

(d) **Called Inspections.** No reinforcing steel or structural framework of any part of any building or structure shall be covered or concealed in any manner whatever without first obtaining the approval of the Building Official.

The Building Official upon notification from the permit holder or his agent shall make the following inspections of Type V buildings and shall either approve that portion of the construction as completed or shall notify the permit holder or his agent wherein the same fails to comply with the law.

1. **FOUNDATION INSPECTION:** To be made after trenches are excavated and forms erected and when all materials for the foundation are delivered on the job. Where concrete from a central mixing plant (commonly termed "transit mixed") is to be used, materials need not be on the job.
2. **FRAME INSPECTION:** To be made after the roof, all framing, fire-blocking, and bracing are in place and all pipes, chimneys, and vents are complete.
3. **LATH INSPECTION:** To be made after all lathing, interior and exterior, is in place and all plastering materials are delivered on the job, but before any plaster is applied.
4. **FINAL INSPECTION:** To be made after building is completed and ready for occupancy.

(e) **Other Inspections.** In addition to the called inspections specified above, the Building Official may make any other inspections of any construction work to ascertain compliance with the provisions of this Code and other laws which are enforced by the Building Department.

For the purpose of determining compliance with Section 104 (i), the Building Official may cause any structure to be reinspected.



**Sec. 305. (a) General.** In addition to the inspections to be made as specified in Section 304, the owner or his agent shall employ a special inspector who shall be present at all times during construction on the following types of work: **Special Inspections**

1. **CONCRETE:** On concrete work when the design is based on an  $f'_c$  in excess of 2000 pounds.
2. **MASONRY:** Masonry work shall have special inspection when required in Chapter 24.
3. **WELDING:** On all structural welding.
4. **REINFORCED GYPSUM:** When cast-in-place reinforced gypsum is being mixed or deposited.
5. **SPECIAL CASES:** On special construction or work involving unusual hazards or requiring constant inspection.

**EXCEPTION:** The Building Official may waive the requirement for the employment of a special inspector if he finds that the construction or work is such that no unusual hazard exists.

**(b) Special Inspector.** The special inspector shall be a qualified person approved by the Building Official.

The special inspector shall furnish continuous inspection on the construction and work requiring his employment. He shall report to the Building Official in writing, noting all Code violations and other information as required.

**Sec. 306. (a) Use or Occupancy.** No building or structure in Groups A to H, inclusive, shall be used or occupied, and no change in the existing occupancy classification of a building or structure or portion thereof shall be made until the Building Official has issued a Certificate of Occupancy therefor as provided herein. **Certificate of Occupancy**

**(b) Change in Use.** Changes in the character or use of a building shall not be made except as specified in Section 502 of this Code.

**(c) Certificate Issued.** After final inspection when it is found that the building or structure complies with the provisions of this Code, and a request has been made by the permittee or owner, the Building Official shall issue a Certificate of Occupancy which shall contain the following:

1. The use and occupancy for which the certificate is issued;
2. A statement that the floor-load signs, as required by Section 2308, have been installed;
3. A statement that the room-capacity signs, as required by Section 3301 (i), have been installed;
4. A certification that the building or structure complies with the provisions of this Code.

**(d) Temporary Certificate.** A temporary Certificate of Occupancy may be issued by the Building Official for the use

**Section 306**

**UNIFORM BUILDING CODE**

**Certificate of  
Occupancy  
(Cont'd.)**

of a portion or portions of a building or structure prior to the completion of the entire building or structure.

(e) **Posting.** The Certificate of Occupancy shall be posted in a conspicuous place on the premises and shall not be removed except by the Building Official.

## PART II

### DEFINITIONS AND ABBREVIATIONS

#### CHAPTER 4—DEFINITIONS AND ABBREVIATIONS

**Sec. 401. General.** For the purpose of this Code, certain abbreviations, terms, phrases, words and their derivatives shall be construed as specified in this Chapter. Words used in the singular include the plural and the plural the singular. Words used in the masculine gender include the feminine, and the feminine the masculine.

#### Definitions and Abbreviations

**Sec. 402. AGRICULTURAL BUILDING** is a building located on agricultural property and used to shelter farm implements, hay, grain, poultry, livestock, or other farm produce, in which there is no human habitation, and which is not used by the public. **A**

**ALLEY** is any public space, public park, or thoroughfare less than sixteen feet (16') but not less than ten feet (10') in width which has been dedicated or deeded to the public for public use.

**ALTER** or **ALTERATION** is any change, addition or modification in construction or occupancy.

**APARTMENT** is a room or suite of rooms which is occupied or which is intended or designed to be occupied by one family for living and sleeping purposes.

**APARTMENT HOUSE** is any building, or portion thereof, which is designed, built, rented, leased, let, or hired out to be occupied, or which is occupied as the home or residence of three or more families living independently of each other and doing their own cooking in the said building, and shall include flats and apartments.

**APPROVED** as to materials and types of construction, refers to approval by the Building Official as the result of investigation and tests conducted by him, or by reason of accepted principles or tests by national authorities, technical or scientific organizations.

**APPROVED AGENCY** is an established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the Building Official.

**AREA** (see "Floor Area").

**ASSEMBLY BUILDING** is a building used, in whole or in part, for the gathering together of persons for such purposes as deliberation, worship, entertainment, amusement, or awaiting transportation.

**Definitions**

**and**

**Abbreviations**

(Cont'd.)

**B**

**ATTIC STORY** is any story situated wholly or partly in the roof, so designated, arranged, or built as to be used for business, storage, or habitation.

**Sec. 403. BALCONY** is that portion of the seating space of an assembly room, the lowest part of which is raised four feet (4') or more above the level of the main floor.

**BASEMENT** is that portion of a building between floor and ceiling, which is partly below and partly above grade (as defined in this Chapter), but so located that the vertical distance from grade to the floor below is less than the vertical distance from grade to ceiling. (See "Story.")

**BAY WINDOW** is a rectangular, curved, or polygonal window, supported on a foundation extending beyond the main wall of the building.

**BUILDING** is any structure built for the support, shelter, or enclosure of persons, animals, chattels, or property of any kind.

**BUILDING, EXISTING**, is a building erected prior to the adoption of this Code, or one for which a legal building permit has been issued.

**BUILDING OFFICIAL** is the officer charged with the administration and enforcement of this Code, or his regularly authorized deputy.

**C**

**Sec. 404. CAST STONE** is a building stone manufactured from cement concrete precast and used as a trim, veneer, or facing on or in buildings or structures.

**CELLAR** is that portion of a building between floor and ceiling which is wholly or partly below grade (as defined in this Chapter) and so located that the vertical distance from grade to the floor below is equal to or greater than the vertical distance from grade to ceiling. (See "Story.")

**CHIEF OF THE FIRE DEPARTMENT** is the head of the Fire Department or his regularly authorized deputy.

**COURT** is an open, unoccupied space, bounded on two or more sides by the walls of the building. An inner court is a court entirely within the exterior walls of a building. All other courts are outer courts.

**D**

**Sec. 405. DEAD LOAD** in a building is the weight of the walls, permanent partitions, framing, floors, roofs, and all other permanent stationary construction entering into and becoming a part of the building.

**DWELLING** is any building or any portion thereof, which is not an "Apartment House" or a "Hotel" as defined in this Code, which contains one or more "Apartments" or "Guest Rooms," used, intended, or designed to be built, used, rented, leased, let, or hired out to be occupied, or which are occupied for living purposes.

**Sec. 406. EXISTING BUILDING.** (See "Building, Existing.") **Definitions (Cont'd.)**

**EXIT** is a continuous and unobstructed means of egress to a public way, and shall include intervening doorways, corridors, ramps, stairways, smokeproof enclosures, horizontal exits, exterior courts, and yards. **E**

**Sec. 407. FAMILY** is one person living alone or a group of two or more persons living together, whether related to each other by birth or not. **F**

**FIRE RESISTANCE** or **FIRE-RESISTIVE CONSTRUCTION** is construction to resist the spread of fire, details of which are specified in Chapters 42 and 43 of this Code.

**FLOOR AREA** is the area included within surrounding walls of a building (or portion thereof), exclusive of vent shafts and courts.

**FOOTING** is that portion of the foundation of a structure which spreads and transmits loads directly to the soil or the piles.

**FRONT OF LOT** is the front boundary line of a lot bordering on the street, and in the case of a corner lot may be either frontage.

**Sec. 408. GARAGE** is a building or portion thereof in which a motor vehicle containing gasoline, distillate or other volatile, flammable liquid in its tank, is stored, repaired, or kept. **G**

**GARAGE, PRIVATE,** is a building, or a portion of a building, not more than one thousand square feet (1000 sq. ft.) in area, in which only motor vehicles used by the tenants of the building or buildings on the premises are stored or kept. (See Section 1501.)

**GARAGE, PUBLIC,** is any garage other than a private garage.

**GRADE (Ground Level)** is the average of the finished ground level at the center of all walls of a building. In case walls are parallel to and within five feet (5') of a sidewalk, the above ground level shall be measured at the sidewalk.

**GRADE (Lumber)** is the classification of lumber in regard to strength and utility.

**GUEST** is any person hiring or occupying a room for living or sleeping purposes.

**Sec. 409. HEIGHT OF BUILDING** is the vertical distance from the "Grade" to the highest point of the coping of a flat roof or to the deck line of a mansard roof or to the average height of the highest gable of a pitch or hip roof. **H**

**HOTEL** is any building containing six or more rooms intended or designed to be used, or which are used, rented or

**Definitions (Cont'd.)** hired out to be occupied, or which are occupied for sleeping purposes by guests.

**I**            **Sec. 410. INCOMBUSTIBLE MATERIAL** is any material which will not ignite at or below a temperature of 1200 degrees Fahrenheit during an exposure of five minutes and which will not continue to burn or glow at that temperature. Tests shall be made as specified in U. B. C. Standard No. 4-1.

**J**            **Sec. 411.** No definitions.

**K**            **Sec. 412.** No definitions.

**L**            **Sec. 413. LINTEL** is the beam or girder placed over an opening in a wall, which supports the wall construction above.  
**LIVE LOADS** are all loads except dead and lateral loads.

**M**            **Sec. 414. MARQUEE** is a permanent roofed structure attached to and supported by the building and projecting over public property. Marquees are regulated in Chapter 45.

**MASONRY** is that form of construction composed of stone, brick, concrete, gypsum, hollow clay tile, concrete block or tile, or other similar building units or materials or combination of these materials laid up unit by unit and set in mortar.

**MASONRY, SOLID**, is masonry of solid units built without hollow spaces.

**MEZZANINE** or **MEZZANINE FLOOR** is an intermediate floor placed in any story or room. When the total area of any such "Mezzanine Floor" exceeds 33⅓ per cent of the total floor area in that room, it shall be considered as constituting an additional "Story." The clear height above or below a "Mezzanine Floor" construction shall be not less than seven feet (7').

**N**            **Sec. 415.** No definitions.

**O**            **Sec. 416. OCCUPANCY** is the purpose for which a building is used or intended to be used. The term shall also include the building or room housing such use. Change of occupancy is not intended to include change of tenants or proprietors.

**ORIEL WINDOW** is a window which projects from the main line of an enclosing wall of a building and is carried on brackets or corbels.

**P**            **Sec. 417. PERSON** is a natural person, his heirs, executors, administrators, or assigns, and also includes a firm, partnership, or corporation, its or their successors or assigns, or the agent of any of the aforesaid.

**PLATFORM, ENCLOSED**, is a partially enclosed portion of an assembly room the ceiling of which is not more than

five feet (5') above the proscenium opening and which is designed or used for the presentation of plays, demonstrations, or other entertainment wherein scenery, drops, decorations, or other effects are to be installed or used. **Definitions (Cont'd.)**

**Sec. 418.** No definitions.

**Q**

**Sec. 419. REPAIR** is the reconstruction or renewal of any part of an existing building for the purpose of its maintenance. The word "Repair" or "Repairs" shall not apply to any change of construction.

**R**

**Sec. 420. SHAFT** is a vertical opening through a building for elevators, dumb-waiter, light, ventilation, or similar purposes.

**S**

**SHALL** as used in this Code, is mandatory.

**STAGE** is a partially enclosed portion of an assembly building which is designed or used for the presentation of plays, demonstrations, or other entertainment wherein scenery, drops, or other effects may be installed or used, and where the distance between the top of the proscenium opening and the ceiling above the stage is more than five feet (5').

**STAIRWAY.** Two or more risers shall constitute a stairway.

**STORY** is that portion of a building included between the upper surface of any floor and the upper surface of the floor next above, except that the topmost story shall be that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above. If the finished floor level directly above a basement or cellar is more than six feet (6') above grade such basement or cellar shall be considered a story.

**STREET** is any thoroughfare or public park not less than sixteen feet (16') in width which has been dedicated or deeded to the public for public use.

**STRUCTURE** is that which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

**Sec. 421.** No definitions.

**T**

**Sec. 422. U.B.C. STANDARDS** is the 1955 Edition of the "Uniform Building Code Standards," also known as "Volume III" of the Uniform Building Code. See Chapter 60.

**U**

**Sec. 423. VALUE or VALUATION** of a building shall be the estimated cost to replace the building in kind, based on current replacement costs, as determined in Section 202 (a).

**V**

**Definitions  
(Cont'd.)**

**VENEER** is a facing of brick, stone, concrete, tile, metal, or similar material attached to a wall for the purpose of providing ornamentation, protection, or insulation but not counted as adding strength to the wall.

**W**

**Sec. 424. WALLS** shall be defined as follows:

**Bearing Wall** is a wall which supports any load other than its own weight.

**Faced Wall** is a wall in which the masonry facing and backing are so bonded as to exert a common action under load.

**Non-Bearing Wall** is a wall which supports no load other than its own weight.

**Parapet Wall** is that part of any wall entirely above the roof line.

**Retaining Wall** is any wall used to resist the lateral displacement of any material.

**WINDOW.** (See "Bay Window"; see "Oriel Window.")

**X**

**Sec. 425.** No definitions.

**Y**

**Sec. 426. YARD** is an open, unoccupied space, other than a court, unobstructed from the ground to the sky, except where specifically provided by this Code, on the lot on which a building is situated.



## PART III

### REQUIREMENTS BASED ON OCCUPANCY

#### CHAPTER 5—CLASSIFICATION OF ALL BUILDINGS BY USE OR OCCUPANCY AND GENERAL REQUIREMENTS FOR ALL OCCUPANCIES

Sec. 501. Every building, whether existing or hereafter erected, shall be classified by the Building Official according to its use or the character of its occupancy, as a building of Group A, B, C, D, E, F, G, H, I, or J, as defined in Chapters 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15, respectively. (See Table No. 5-A.)

**Occupancy  
Classified**

Any occupancy not mentioned specifically or about which there is any question shall be classified by the Building Official and included in the Group which its use most nearly resembles based on the existing or proposed life and fire hazard.

Sec. 502. No change shall be made in the character of occupancy or use of any building which would place the building in a different Group of occupancy, unless such building is made to comply with the requirements of this Code for that Group.

**Change  
in Use**

**EXCEPTION:** The character of the occupancy of existing buildings may be changed subject to the approval of the Building Official, and the building may be occupied for purposes in other Groups without conforming to all the requirements of this Code for those Groups, provided the new or proposed use is less hazardous, based on life and fire risk, than the existing use.

No change in the character of occupancy of a building shall be made without a Certificate of Occupancy, as required in Section 306 of this Code.

Sec. 503. (a) General. When a building is used for more than one occupancy purpose each part of the building comprising a distinct "Occupancy," as described in Chapters 5 to 15, shall be separated from any other occupancy as specified in Section 503 (d).

**Mixed  
Occupancy**

When a building is used for more than one occupancy purpose, it shall be subject to the most restrictive requirements for the occupancies concerned.

**EXCEPTIONS:** 1. When a one-story building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. The maximum floor area of any separate occupancy shall be the area allowed by Section 505, multiplied

**Mixed  
Occupancy  
(Cont'd.)**

by the percentage of the building occupied by such occupancy.

2. Where minor accessory uses do not occupy more than 10 per cent of the area of any floor of a building, the major use of the building shall determine the occupancy classification provided the uses are separated as specified in Section 503 (d).

(b) **Forms of Occupancy Separations.** Occupancy separations shall be vertical or horizontal or both or, when necessary, of such other form as may be required to afford a complete separation between the various occupancy divisions in the building.

(c) **Types of Occupancy Separation.** Occupancy separations shall be classed as "Four-Hour Fire-Resistive," "Three-Hour Fire-Resistive," "Two-Hour Fire-Resistive," and "One-Hour Fire-Resistive."

1. A "Four-Hour Fire-Resistive Occupancy Separation" shall have no openings therein and shall be of not less than four-hour fire-resistive construction.

2. A "Three-Hour Fire-Resistive Occupancy Separation" shall be of not less than three-hour fire-resistive construction. All openings in walls forming such separation shall be protected on each side thereof by Class "A" fire doors and such doors shall be kept normally closed. The total width of all openings in any "Three-Hour Fire-Resistive Occupancy Separation" wall in any one story shall not exceed 25 per cent of the length of the wall in that story and no single opening shall have an area greater than one hundred and twenty square feet (120 sq. ft.).

All openings in floors forming a "Three-Hour Fire-Resistive Occupancy Separation" shall be protected by vertical enclosures, extending above and below such openings. The walls of such vertical enclosures shall be of not less than two-hour fire-resistive construction and all openings therein shall be protected on one side thereof by Class "B" fire doors, and such doors shall be kept normally closed.

3. A "Two-Hour Fire-Resistive Occupancy Separation" shall be of not less than two-hour fire-resistive construction. All openings in such separations shall be protected on one side by Class "B" fire doors, and such doors shall be kept normally closed.

4. A "One-Hour Fire-Resistive Occupancy Separation" shall be of not less than one-hour fire-resistive construction. All openings in such separations shall be protected with Class "C" fire doors, and such doors shall be kept normally closed.

(d) **Fire Ratings for Occupancy Separations.** Occupancy separations shall be provided between the various groups and divisions of occupancies as set forth in Table No. 5-B. Where any occupancy separation is required the minimum shall be a "One-Hour Fire-Resistive Occupancy Separation." Where the occupancy separation is horizontal, structural members supporting the separation shall be protected by equivalent fire-resistive construction.

**Sec. 504. (a) General.** Buildings shall adjoin a public space, yard, or street on not less than one side. Required yards shall be permanently maintained.

**Location  
on  
Property**

For the purpose of this Section, the center line of an adjoining street or alley shall be considered an adjacent property line.

**(b) Fire Resistance of Walls.** Exterior walls shall have fire-resistance and opening protection as set forth in Table No. 5-A, Part III, and in accordance with such additional provisions as are specified in Part V. Distance shall be measured at right angles from the property line. The above provisions shall not apply to walls at right angles to the property line.

**(c) Buildings on Same Property.** For the purpose of determining the required exterior wall protection, buildings on the same property shall be assumed to have a property line between them.

When a new building is to be erected on the same property with an existing building, the assumed property line from the existing building shall be the distance to the property line for each occupancy as set forth in Table No. 5-A.

**EXCEPTION:** Two or more buildings on the same property may be considered as portions of one building if the area within a line circumscribing the buildings is within the limits specified in Section 505. In this case, the space between buildings shall be considered an inner court for the purpose of determining the exterior wall construction.

When the buildings so considered house different occupancies or are of different types of construction, the area shall be that allowed for the most restricted occupancy or construction.

**Sec. 505. (a) One-Story Areas.** The area of a one-story building shall not exceed the limits set forth in Table No. 5-C except as provided in Section 506, nor the limits specified in Chapter 16.

**Allowable  
Floor Areas**

**(b) Areas of Buildings Over One Story.** The total area of all floors of buildings over one story in height shall not exceed 200 per cent of the area allowed for one-story buildings. No single floor area shall exceed that permitted for one-story buildings. Basements and cellars need not be included in the total allowable areas.

For buildings located in Fire Zones 1 and 2 the basic area shall be reduced 25 per cent.

**(c) Separation of Areas.** For the purpose of this Section, each portion of a building separated by one or more continuous fire-resistive walls extending from the foundation to the roof at all points may be considered a separate building. Such area separation wall shall be not less than four-hour fire-resistive in buildings of Types I, II, and III construction with openings protected as required for Class "A" openings and shall be not less than two-hour fire-resistive in buildings of Types IV and V construction with openings protected as

**TABLE NO. 5-A—WALL AND OPENING PROTECTION OF OCCUPANCIES BASED ON LOCATION ON PROPERTY**

**TYPES IV AND V CONSTRUCTION:** For exterior wall and opening protection of Type IV and V buildings see table below. Type V construction is not permitted within Fire Zone No. 1. For exceptions to limitations for Type IV construction, see Sections 1109, 1602, and 2103.

**(TYPES I, II, AND III CONSTRUCTION:** Exterior walls and protection of openings shall be as specified in Sections 1803, 1903, and 2003.)

| GROUP                           | DESCRIPTION OF OCCUPANCY  | FIRE ZONE | FIRE RESISTANCE OF EXTERIOR WALLS                        | OPENINGS IN EXTERIOR WALLS                                    |
|---------------------------------|---|-----------|--|---|
| A                               | Any assembly building with a stage and an occupant load of 1000 or more in the building.....  |           | Permitted in Type I Buildings only [See Section 602 (a)] |   |
| B<br>See also<br>Section<br>702 | 1—Any assembly building with a stage and an occupant load of less than 1000 in the building.....  | 1         | 2 hour less than 20 feet<br>1 hour elsewhere             | Not permitted less than 5 feet<br>Protected less than 20 feet |
|                                 | 2—Any assembly building without a stage and having an occupant load of 300 or more in the building.....   | 2 and 3   | 2 hour less than 10 feet<br>1 hour elsewhere             | Not permitted less than 5 feet<br>Protected less than 10 feet |
|                                 | 3—Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for school purposes less than four hours per week.....                              | 1         | 2 hour less than 20 feet<br>1 hour elsewhere             | Not permitted less than 5 feet<br>Protected less than 10 feet |
|                                 |   | 2         | 2 hour less than 5 feet<br>1 hour elsewhere              |   |
|                                 |   | 3         | 2 hour less than 5 feet<br>1 hour less than 10 feet      |   |
|                                 | 4—Stadiums, reviewing stands, and amusement park structures not included within Group A nor Divisions 1, 2 and 3, Group B, occupancies .....  | 1         | 2 hour less than 20 feet<br>1 hour elsewhere             | Protected less than 20 feet                                   |
|                                 |   | 2         | 1 hour everywhere  | Protected less than 10 feet                                   |
|                                 |   | 3         | 1 hour less than 10 feet                                 |   |
| C<br>See also<br>Section<br>802 | Any building used for school or day-care purposes more than four hours per week, involving assemblage for instruction, education, or recreation, and not classed in Group A or Divisions 1 and 2, Group B, occupancies. | 1         | 2 hour less than 20 feet<br>1 hour elsewhere             | Not allowed less than 5 feet<br>Protected less than 20 feet   |
|                                 |   | 2         | 2 hour less than 10 feet<br>1 hour elsewhere             | Not allowed less than 5 feet<br>Protected less than 10 feet   |
|                                 |   | 3         | 2 hour less than 5 feet<br>1 hour less than 10 feet      | Not allowed less than 5 feet                                  |

NOTES: (1) All distances given are in feet from the property line to the wall. (See Section 504 and Part V.)  
 (2) For additional restrictions see Chapters under Occupancy, Fire Zones, and Types of Construction.  
 (3) For walls facing streets and public ways see Part V.

(Continued)

|                                  |  |         |   |   |
|----------------------------------|--|---------|---|---|
| D<br>See also<br>Section<br>902  | 1—Mental hospitals, jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained .....  |         | Permitted in Type I and II Buildings only [See Section 902 (b)]                                 |   |
|                                  | 2—Nurseries for full-time care of children under kindergarten age. Hospitals, sanitariums, mental sanitariums conforming to Sec. 3319 (g), and similar buildings (each accommodating more than six persons.)   | 1       | 2 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 5 feet<br>Protected less than 20 feet |
|                                  |  | 2 and 3 | 2 hour less than 5 feet<br>1 hour elsewhere   | Not permitted less than 5 feet<br>Protected less than 10 feet |
|                                  | 3—Homes for the aged and homes for children of kindergarten age or older (each accommodating more than six persons).....   | 1       | 2 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 3 feet<br>Protected less than 20 feet |
|                                  |  | 2 and 3 | 1 hour everywhere   | Not permitted less than 3 feet<br>Protected less than 10 feet |
|                                  |  |         | Not permitted in Fire Zones Nos. 1 and 2  |   |
| E<br>See also<br>Section<br>1002 | 1—Storage and handling of hazardous and highly inflammable or explosive materials other than flammable liquids.....  | 3       | 4 hour less than 5 feet<br>2 hour less than 10 feet<br>1 hour less than 20 feet                 | Not permitted less than 5 feet                                |
|                                  | 2—Storage and handling of Class I, II, and III flammable liquids, as specified in U.B.C. Standard No. 9-1; dry cleaning plants using flammable liquids, paint stores with bulk handling; paint shops and spray painting rooms and shops.....   | 1       | 4 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 5 feet<br>Protected less than 20 feet |
|                                  | 3—Woodworking establishments, planing mills and box factories; shops, factories where loose, combustible fibers or dust are manufactured, processed, or generated; warehouses where highly combustible material is stored.....   | 2       | 4 hour less than 5 feet<br>2 hour less than 10 feet<br>1 hour elsewhere                         | Not permitted less than 5 feet                                |
|                                  | 4—Repair garages.....  | 3       | 4 hour less than 5 feet<br>2 hour less than 10 feet<br>1 hour less than 20 feet                 | Not permitted less than 5 feet                                |
|                                  | 5—Aircraft repair hangars.....   |         | Not permitted in Fire Zones Nos. 1 and 2 except as set forth in Sections 1602 (c) and 1603 (c). |   |
|                                  |  | 3       | 1 hour less than 60 feet  | Protected less than 60 feet                                   |
| F<br>See also<br>Section<br>1102 | 1—Gasoline and service stations, storage garages where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.....   | 1       | 2 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 5 feet<br>Protected less than 20 feet |
|                                  | 2—Wholesale and retail stores, office buildings, restaurants, undertaking parlors, printing plants, municipal police and fire stations, factories and workshops using material not highly flammable or combustible, storage and sales rooms for combustible goods, paint stores without bulk handling..... | 2       | 1 hour everywhere   | Not permitted less than 5 feet<br>Protected less than 10 feet |
|                                  |  | 3       | 1 hour less than 10 feet  | Protected less than 10 feet                                   |
|                                  | 3—Aircraft hangars where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.....   | 1       | 2 hour less than 20 feet<br>1 hour elsewhere  | Protected less than 20 feet                                   |
|                                  | Open parking garages. (For requirements, see Section 1109.)  | 2       | 1 hour everywhere   |   |
|                                  |  | 3       | 1 hour less than 20 feet  |   |

See Notes, page 40.

(Continued)

**TABLE NO. 5-A—WALL AND OPENING PROTECTION OF OCCUPANCIES BASED ON LOCATION  
ON PROPERTY**  
(Continued)

| GROUP                            | DESCRIPTION OF OCCUPANCY  | FIRE ZONE | FIRE RESISTANCE OF EXTERIOR WALLS   | OPENINGS IN EXTERIOR WALLS                                    |
|----------------------------------|---|-----------|---|---|
| G                                | Ice plants, power plants, pumping plants, cold storage, and creameries, factories and workshops using incombustible and non-explosive materials. Storage and sales rooms of incombustible and non-explosive materials ..... | 1         | 2 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 3 feet<br>Protected less than 20 feet |
|                                  |   | 2         | 1 hour everywhere   | Not permitted less than 3 feet<br>Protected less than 10 feet |
|                                  |   | 3         | 1 hour less than 3 feet   | Not permitted less than 3 feet                                |
| H<br>See also<br>Section<br>1302 | Hotels, apartment houses, dormitories, lodging houses.<br>Convents, monasteries (each accommodating more than 10 persons) ..  | 1         | 2 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 3 feet<br>Protected less than 20 feet |
|                                  |   | 2         | 1 hour everywhere   | Not permitted less than 3 feet<br>Protected less than 10 feet |
|                                  |   | 3         | 1 hour less than 3 feet   | Not permitted less than 3 feet<br>Protected less than 5 feet  |
| I                                | Dwellings .....   | 1         | 2 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 3 feet<br>Protected less than 20 feet |
|                                  |   | 2         | 1 hour everywhere   | Not permitted less than 3 feet<br>Protected less than 10 feet |
|                                  |   | 3         | 1 hour less than 3 feet   | Not permitted less than 3 feet                                |
| J                                | 1—Private garages, sheds and minor buildings used as accessories only when not over one thousand square feet (1000 sq. ft.) in area.....  | 1         | 2 hour less than 20 feet<br>1 hour elsewhere  | Not permitted less than 3 feet<br>Protected less than 20 feet |
|                                  |   | 2         | 1 hour everywhere   | Not permitted less than 3 feet<br>Protected less than 10 feet |
|                                  |   | 3         | 1 hour less than 3 feet<br>(Or may be protected on the exterior with materials approved for 1 hour fire-resistive construction) | Not permitted less than 3 feet                                |
|                                  | 2—Fences over six feet (6') high, tanks and towers.....   | 1         | Incombustible construction not regulated<br>Combustible construction not permitted  |   |
|                                  |   | 2         | Incombustible construction not regulated<br>Combustible construction to be 1-hour fire-resistive                                |   |
|                                  |   | 3         | Not regulated   |   |

See Notes, page 40.

**TABLE NO. 5-B—REQUIRED SEPARATIONS IN BUILDINGS  
OF MIXED OCCUPANCY  
(In Hours)**

| GROUP | A | B | C | D | E-1 | E-2 | E-3 | E-4-5 | F-1 | F-2 | F-3 | G | H | I | J  |
|-------|---|---|---|---|-----|-----|-----|-------|-----|-----|-----|---|---|---|----|
| A     | N | N | N | 3 | 4   | 4   | 4   | 4     | 4   | 3   | 3   | 3 | 1 | 1 | 1  |
| B     |   | N | N | 3 | 4   | 4   | 4   | 4     | 3   | 1   | 1   | 1 | 1 | 1 | 1  |
| C     |   |   | N | 1 | 4   | 4   | 4   | 4     | 4   | 1   | 1   | 1 | 1 | 1 | 1  |
| D     |   |   |   | N | 4   | 4   | 4   | 4     | 4   | 4   | 4   | 4 | 1 | 1 | 3  |
| E-1   |   |   |   |   | N   | 1   | 1   | 1     | 2   | 2   | 2   | 2 | 4 | 4 | 1  |
| E-2   |   |   |   |   |     | N   | 1   | 1     | 1   | 1   | 1   | 1 | 3 | 3 | 1  |
| E-3   |   |   |   |   |     |     | N   | 1     | 1   | 1   | 1   | 1 | 3 | 3 | 1  |
| E-4-5 |   |   |   |   |     |     |     | N     | 1   | 1   | 1   | 1 | 3 | 3 | 1  |
| F-1   |   |   |   |   |     |     |     |       | N   | 1   | 1   | 1 | 3 | 1 | 1  |
| F-2   |   |   |   |   |     |     |     |       |     | N   | 1   | 1 | 1 | N | 1  |
| F-3   |   |   |   |   |     |     |     |       |     |     | N   | 1 | 1 | N | 1  |
| G     |   |   |   |   |     |     |     |       |     |     |     | N | 1 | N | N  |
| H     |   |   |   |   |     |     |     |       |     |     |     |   | N | N | 1  |
| I     |   |   |   |   |     |     |     |       |     |     |     |   |   | N | 1* |
| J     |   |   |   |   |     |     |     |       |     |     |     |   |   |   | N  |

\*Provided that materials as approved for one-hour fire-resistive construction on the garage side and a self-closing, tight-fitting solid wood door one and three-eighths inches (1 $\frac{3}{8}$ " ) in thickness, shall be permitted.

**TABLE NO. 5-C—BASIC ALLOWABLE FLOOR AREA FOR BUILDINGS ONE STORY IN HEIGHT\***

(In Square Feet)

| Occupancy       | TYPES OF CONSTRUCTION |               |                   |                        |        |                        |        |                        |
|-----------------|-----------------------|---------------|-------------------|------------------------|--------|------------------------|--------|------------------------|
|                 | I                     | II            | III               |                        | IV     |                        | V      |                        |
|                 |                       |               | 1-Hour or<br>H.T. | N                      | 1-Hour | N                      | 1-Hour | N                      |
| <b>A</b>        | Unlimited             | Not Permitted |                   |                        |        |                        |        |                        |
| <b>B) 1-2</b>   | Unlimited             | 18,000        | 13,500            | Not Permitted          | 13,500 | Not Permitted          | 10,500 | Not Permitted          |
| <b>B) 3-4</b>   | Unlimited             | 18,000        | 13,500            | 9,000                  | 13,500 | 9,000                  | 10,500 | 6,000                  |
| <b>C</b>        | Unlimited             | 27,000        | 20,250            | 13,500                 | 20,250 | 13,500                 | 15,750 | 9,000                  |
| <b>D) 1</b>     | Unlimited             | 9,000         | Not Permitted     |                        |        |                        |        |                        |
| <b>D) 2-3</b>   | Unlimited             | 9,000         | 6,750             | Not Permitted          | 6,750  | Not Permitted          | 5,250  | Not Permitted          |
| <b>E) 1-2</b>   | 15,000                | 7,500         | 5,625             | 3,750                  | 5,625  | 3,750                  | 4,375  | 2,500                  |
| <b>E) 3-4-5</b> | Unlimited             | 15,000        | 11,250            | 7,500                  | 11,250 | 7,500                  | 8,750  | 5,000                  |
| <b>F) 1-2-3</b> | Unlimited             | 24,000        | 18,000            | 12,000                 | 18,000 | 12,000                 | 14,000 | 8,000                  |
| <b>G</b>        | Unlimited             | 36,000        | 27,000            | 18,000                 | 27,000 | 18,000                 | 21,000 | 12,000                 |
| <b>H</b>        | Unlimited             | 18,000        | 13,500            | 9,000<br>Sec. 1302 (b) | 13,500 | 9,000<br>Sec. 1302 (b) | 10,500 | 6,000<br>Sec. 1302 (b) |
| <b>I</b>        | Unlimited             |               |                   |                        |        |                        |        |                        |
| <b>J</b>        | See Chapter 15        |               |                   |                        |        |                        |        |                        |

N.—No general requirements for fire resistance.

H. T.—Heavy Timber.

\*For buildings located in Fire Zones 1 and 2, the basic area shall be reduced 25 per cent.



required for Class "D" openings. The total width of all openings in such fire-resistive wall, in each story, shall not exceed 25 per cent of the length of the wall in that story.

See Chapters 6 to 16 inclusive for special occupancy provisions.

**Sec. 506. (a) General.** The increases of floor areas permitted in this Section may be compounded when applicable, except that such increases for approved automatic fire-extinguishing systems shall not apply when other provisions of this Code require such fire-extinguishing installation.

**Allowable  
Area  
Increases**

**(b) Separation on Two Sides.** Where public space, streets, or yards, more than twenty feet (20') in width, extend along two sides of a building, the areas specified in Section 505 may be increased at a rate of  $1\frac{1}{4}$  per cent for each foot by which the minimum width exceeds twenty feet (20'), but the increase shall not exceed 50 per cent.

**(c) Separation on Three Sides.** Where public space, streets, or yards, more than twenty feet (20') in width, extend along three sides of a building, the areas specified in Section 505 may be increased at a rate of  $2\frac{1}{2}$  per cent for each foot by which the minimum width exceeds twenty feet (20'), but the increase shall not exceed 100 per cent.

**(d) Separation on All Sides.** Where public space, streets, or yards, more than twenty feet (20') in width, extend on all sides of one- and two-story buildings and adjoin the entire perimeter, the areas specified in Section 505 may be increased at a rate of 5 per cent for each foot by which the minimum width exceeds twenty feet (20'). Such increases shall not exceed 100 per cent, except for buildings not exceeding two stories in height of Group G occupancy and one-story buildings housing aircraft storage hangars and as further limited in Section 1002 (b) for aircraft repair hangars.

**(e) Unlimited Area.** The area of any one- or two-story building of Group F, Group G, and Division 5 of Group E occupancies shall not be limited, if the building is provided with an approved automatic fire-extinguishing system throughout, as specified in Chapter 38, and entirely surrounded by public space, streets, or yards not less than sixty feet (60') in width.

The area of a one-story Type II or Type IV building of Group G occupancy shall not be limited if the building is entirely surrounded by public space, streets, or yards not less than sixty feet (60') in width.

**(f) Sprinklers.** The areas specified in Section 505 may be tripled in one-story buildings and doubled in buildings of more than one story if the building is provided with an approved automatic fire-extinguishing system throughout as specified in Chapter 38.

TABLE NO. 5-D—MAXIMUM HEIGHT OF BUILDINGS

Table No. 5-D

46

| OCCUPANCY                 | TYPES OF CONSTRUCTION  |                   |                   |               |                   |               |                   |               |
|---------------------------|------------------------|-------------------|-------------------|---------------|-------------------|---------------|-------------------|---------------|
|                           | I                      | II                | III               |               | IV                |               | V                 |               |
|                           |                        |                   | 1-Hr.orH.T.       | N             | 1-Hour            | N             | 1-Hour            | N             |
|                           | MAXIMUM HEIGHT IN FEET |                   |                   |               |                   |               |                   |               |
|                           | Unlimited              | 95'               | 65'               | 55'           | 65'               | 55'           | 50'               | 40'           |
| MAXIMUM HEIGHT IN STORIES |                        |                   |                   |               |                   |               |                   |               |
| A                         | Unlimited              | Not Permitted     |                   |               |                   |               |                   |               |
| B) 1-2                    | Unlimited              | 4                 | 2                 | Not Permitted | 2                 | Not Permitted | 2                 | Not Permitted |
| B) 3-4                    | Unlimited              | 4                 | 2                 | 1             | 2                 | 1             | 2                 | 1             |
| C                         | Unlimited              | 4<br>Sec. 802 (b) | 2<br>Sec. 802 (b) | 1             | 2<br>Sec. 802 (b) | 1             | 2<br>Sec. 802 (b) | 1             |
| D) 1                      | Unlimited              | 2                 | Not Permitted     |               |                   |               |                   |               |
| D) 2                      | Unlimited              | 3                 | 1                 | Not Permitted | 1                 | Not Permitted | 1                 | Not Permitted |
| D) 3                      | Unlimited              | 3                 | 2                 | Not Permitted | 2                 | Not Permitted | 2                 | Not Permitted |
| E) 1                      | Unlimited              | 2                 | 1                 | 1             | 1                 | 1             | 1                 | 1             |
| E) 2-3-4-5                | Unlimited              | 2                 | 2                 | 1             | 2                 | 1             | 2                 | 1             |
| F) 1-2-3                  | Unlimited              | 6                 | 4                 | 2             | 4                 | 2             | 3                 | 2             |
| G                         | Unlimited              | 6                 | 4                 | 2             | 4                 | 2             | 3                 | 2             |
| H                         | Unlimited              | 5                 | 4                 | 2             | 4                 | 2             | 3                 | 2             |
| I                         | Unlimited              | 3                 | 3                 | 3             | 3                 | 3             | 3                 | 3             |
| J                         | See Chapter 15         |                   |                   |               |                   |               |                   |               |

N.—No general requirements for fire resistance.  
H. T. Heavy Timber

UNIFORM BUILDING CODE

**Sec. 507.** The maximum height and number of stories of every building shall be dependent upon the character of the occupancy and the type of construction, and shall not exceed the limits set forth in Table No. 5-D, except as provided in this Section. The height shall be measured from the highest adjoining sidewalk or ground surface, provided that the height measured from the lowest adjoining surface shall not exceed such maximum height by more than ten feet (10').

**Maximum  
Height of  
Buildings  
and  
Increases**

The limits set forth in Table No. 5-D may be increased by one story if the building is provided with an automatic fire-extinguishing system throughout installed in accordance with the provisions of Chapter 38. The increase in height for sprinklers shall not apply when other provisions of this Code require automatic fire-extinguishing systems throughout or when the increases under Section 506 (f) are used.

**EXCEPTIONS:** 1. Towers, spires, and steeples erected as a part of a building and not used for habitation or storage may extend not to exceed twenty feet (20') above such height limit.

2. The height of one-story aircraft hangars shall not be limited if the building is provided with automatic fire-extinguishing systems throughout as specified in Chapter 38 and is entirely surrounded by public space, streets, or yards not less in width than 150 per cent of the height of the building.

See Chapters 6 to 16 inclusive for special occupancy provisions.

**Sec. 508.** Where one-hour fire-resistive construction throughout is required by this Code, an approved automatic fire-extinguishing system, as specified in Chapter 38, may be substituted, provided such system is not otherwise required.

**Fire-Resistive  
Substitution**

**Sec. 509.** Arcades connecting buildings and used exclusively as passageways need not be considered as adjacent buildings for the provisions of this Chapter, provided that the walls of the building adjoining the arcades are finished with the same construction as required for the exterior walls of the building, with no communicating openings between the arcades and the building, except doors; and provided that the arcades are of not less than one-hour fire-resistive construction or entirely of incombustible materials, or of heavy timber construction with two-inch (2") nominal sheathing.

**Arcades**

## CHAPTER 6—REQUIREMENTS FOR GROUP A OCCUPANCIES

### Group A Occupancies Defined

**Sec. 601.** Group A Occupancies shall be:

Any assembly building with a stage and an occupant load of 1000 or more in the building.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

### Construction, Height, and Area Allowable

**Sec. 602. (a) General.** Buildings or parts of buildings classed in Group A because of the use or character of the occupancy shall be of Type I construction and shall not be limited as to location in fire zones, occupant load, height, or area.

**(b) Special Provisions.** Stages and enclosed platforms as defined in Sections 420 and 417 shall be constructed in accordance with Chapter 39.

The slope of the main floor of the assembly room shall not exceed one in five.

### Location on Property

**Sec. 603.** Buildings housing Group A occupancies shall front directly upon at least one public street not less than twenty feet (20') in width, in which front shall be located the main entrance and exit of such building. The main assembly floor shall be located at or near the adjacent ground level.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 1803.

### Exit Facilities

**Sec. 604.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

### Light, Ventilation, and Sanitation

**Sec. 605.** All portions of Group A occupancies customarily used by human beings and all dressing rooms shall be provided with light and ventilation by means of windows or skylights with an area not less than one-eighth of the total floor area, one-half of which shall be openable, or shall be provided with artificial light and a mechanically operated ventilating system. The mechanically operated ventilating system shall supply a minimum of five cubic feet (5 cu. ft.) per minute of outside air with a total circulated of not less than fifteen cubic feet (15 cu. ft.) per minute per occupant in all portions of the building and such system shall be kept continuously in operation during such time as the building is occupied. If the velocity of the air at the register exceeds ten feet (10') per second, the register shall be placed more than eight feet (8') above the floor directly beneath.

Lights in all parts of the building customarily used by human beings shall be on a separate circuit from that of the stage and shall be controlled from the box office. All lights in corridors, exit courts and exit passageways shall be protected by a wire cage.

All registers or vents supplying air backstage shall be

equipped with automatic closing devices with fusible links. Such closing devices shall be located where the vents or ducts pass through the proscenium walls and shall be operated by fusible links located on both sides of the proscenium wall and both inside of and outside of the vent or duct.

**Light,  
Ventilation,  
and  
Sanitation  
(Cont'd.)**

There shall be provided in an approved location at least one lavatory for each two toilets for each sex, and at least one drinking fountain for each floor level.

For requirements for floors and walls of toilet compartments, see Section 1711.

**Sec. 606.** Exits shall be enclosed as specified in Chapter 33. Elevator shafts, vent shafts, and other vertical openings shall be enclosed and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Enclosure  
of Vertical  
Openings**

**Sec. 607.** Automatic fire-extinguishing systems, standpipes, and basement pipe inlets shall be installed as specified in Chapter 38.

**Fire-  
Extinguishing  
Systems**

**Sec. 608.** Stages shall be equipped with automatic ventilators as required in Section 3901.

**Special  
Hazards**

Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Flammable liquids shall not be placed or stored in any Group A occupancy.

Every gas service to the stage portion of the building shall be separated from any other service to the building and each building shall be provided with an approved shut-off valve at a convenient and conspicuous place outside the building and adequately marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

**EXCEPTION:** Where boilers and central heating plants burning liquid or solid fuel are located at grade level, they may be separated from the remainder of the building by a "One-Hour Fire-Resistive Occupancy Separation."

**Sec. 609.** Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.

**Exceptions  
and  
Deviations**

## CHAPTER 7—REQUIREMENTS FOR GROUP B OCCUPANCIES

### Group B Occupancies Defined

**Sec. 701.** Group B Occupancies shall be:

**Division 1.** Any assembly building with a stage and an occupant load of less than 1000 in the building.

**Division 2.** Any assembly building without a stage and having an occupant load of 300 or more in the building.

**Division 3.** Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for school purposes less than four hours per week.

**Division 4.** Stadiums, reviewing stands, and amusement park structures not included within Group A nor Divisions 1, 2, and 3, Group B, occupancies.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

### Construction, Height, and Area Allowable

**Sec. 702. (a) General.** Buildings or parts of buildings classed in Group B because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**EXCEPTION:** Division 4 structures of open skeleton frame type shall not be limited in area or height.

**(b) Special Provisions.** Stages and enclosed platforms as defined in Sections 420 and 417 shall be constructed in accordance with Chapter 39.

Divisions 1 and 2 occupancies shall be of not less than one-hour fire-resistive construction throughout, except that a fire-resistive ceiling shall not be required in one-story buildings of Type III, IV, or V construction having an open frame roof. Division 2 occupancies with an occupant load of 1000 or more shall be of Type I, II, or III construction.

**EXCEPTION:** Gymnasiums which have not more than two balconies, each with an occupant load not to exceed 300, and which are not located over usable spaces, need not have one-hour fire-resistive protection.

Division 3 occupancies located in a basement or above the first story shall be of not less than one-hour fire-resistive construction.

Group B assembly rooms having an occupant load of 1000 or more shall not be located in the basement.

Division 3 occupancies with an occupant load of 50 or more, which are located over usable space, shall be separated from such space by not less than one-hour fire-resistive construction.

For attic space partitions and draft stops see Section 3205.

**(c) Division 4 Provisions.** Erection and structural maintenance of structures housing Division 4 occupancies shall conform to the requirements of this Code, and where there are no such specific requirements, shall provide adequate safety for the loads to which they may be subjected.

Structures housing Division 4 occupancies, other than those of open skeleton frame type, when more than one story in height or four hundred square feet (400 sq. ft.) in area, shall be of not less than one-hour fire-resistive construction.

**Construction,  
Height,  
and Area  
Allowable  
(Cont'd.)**

When the space under a Division 4 occupancy is used for any purpose, it shall be separated from all parts of such Division 4 occupancy, including exits, by walls, floors, and ceilings of not less than one-hour fire-resistive construction.

The Building Official may cause all Division 4 structures to be re-inspected at least once every six months.

**Sec. 703.** All buildings housing Group B occupancies shall front directly upon at least one public street, not less than twenty feet (20') in width, in which front shall be located the main entrance of such building.

**Location on  
Property**

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

**Sec. 704. (a) General.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

**Exit  
Facilities**

**(b) Amusement Structures.** Stairs and exits for Division 4 amusement structures shall be provided as specified in Chapter 33, subject to the approval of the Building Official. Exit signs shall be installed as specified in Section 3312 and where required by the Building Official.

**Sec. 705.** All portions of Group B occupancies customarily used by human beings and all dressing rooms shall be provided with natural or artificial light, ventilation, and sanitary facilities as specified in Sections 605 and 1711.

**Light,  
Ventilation,  
and  
Sanitation**

**Sec. 706.** Exits shall be enclosed as specified in Chapter 33. Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Enclosure  
of Vertical  
Openings**

**Sec. 707.** Automatic fire-extinguishing systems, standpipes, and basement pipe inlets shall be installed as specified in Chapter 38.

**Fire-  
Extinguishing  
Systems**

**Sec. 708.** Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

**Special  
Hazard**

Motion picture machine booths shall conform to the requirements of Chapter 40.

Flammable liquids shall not be placed or stored in a Group B occupancy.

Each building shall be provided with an approved outside gas shut-off valve conspicuously marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors

**Special  
Hazards  
(Cont'd.)**

or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

**EXCEPTION:** Where boilers and central heating plants burning liquid or solid fuel are located at grade level, they may be separated from the remainder of the building by a "One-Hour Fire-Resistive Occupancy Separation."

**Exceptions  
and  
Deviations**

**Sec. 709.** Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.

In gymnasiums and in multipurpose schoolrooms having an area not greater than thirty-two hundred square feet (3,200 sq. ft.), one-inch (1") nominal tight tongue-and-grooved or three-quarter-inch ( $\frac{3}{4}$ ") plywood wall covering may be used on the inner side in lieu of fire-resistive plaster.



## CHAPTER 8—REQUIREMENTS FOR GROUP C OCCUPANCIES

**Sec. 801.** Group C Occupancies shall be:

Any building used for school or day-care purposes more than four hours per week, involving assemblage for instruction, education, or recreation, and not classed in Group A occupancies or in Divisions 1 and 2 of Group B occupancies.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

**Group C  
Occupancies  
Defined**

**Sec. 802. (a) General.** Buildings or parts of buildings classed in Group C because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**Construction,  
Height,  
and Area  
Allowable**

**(b) Special Provisions.** Rooms having an occupant load of more than 100, and rooms used for kindergarten, first- or second-grade pupils, shall not be located above the first story above grade except in buildings of Type I construction.

Laboratories, wood-working and metal-working shops, machine shops, paint shops, storage rooms, and similar areas shall be separated from each other and from classrooms by not less than a "One-Hour Fire-Resistive Occupancy Separation."

Where there is usable space under the first floor of two-story Type III, IV, and V buildings, the construction up to and including the first floor shall be of Type I construction, and the first floor shall be unpierced for human access.

Balconies and bleachers over usable space and all janitor closets shall be protected with materials approved for one-hour fire-resistive construction.

All curtains, drops, and drapes shall be flame-proofed.

Stages and enclosed platforms shall be constructed in accordance with Chapter 39.

The provisions of Section 1803 (b) shall not apply to openings in buildings not more than three stories high when such openings are not less than thirty feet (30') from adjacent property lines and not less than thirty feet (30') from buildings on the same property.

For attic space partitions and draft stops, see Section 3205.

**Sec. 803. (a) General.** Group C occupancies shall front directly upon at least one public street, not less than twenty feet (20') in width, in which front shall be located at least one required exit.

**Location on  
Property**

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

**(b) Special Provision.** Exterior walls or parts of walls of Group C occupancies having an occupant load of less than

100 persons, when within ten feet (10') of adjacent property lines, may be of one-hour fire-resistive construction.

**Exit  
Facilities**

**Sec. 804.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

**Light,  
Ventilation,  
and  
Sanitation**

**Sec. 805.** All portions of Group C occupancies shall be provided with light and ventilation, either natural or artificial, as specified in Section 605.

Toilets shall be provided on the basis of the following ratios of toilets to number of students:

|                          | Girls | Boys  |
|--------------------------|-------|-------|
| Elementary Schools ..... | 1:35  | 1:100 |
| Secondary Schools .....  | 1:45  | 1:100 |

In addition, urinals shall be provided for boys on a basis of 1:30.

There shall be provided at least one lavatory for each two toilets or urinals for each sex and at least one drinking fountain on each floor.

For requirements for floors and walls of toilet compartments, see Section 1711.

**Enclosure  
of Vertical  
Openings**

**Sec. 806.** Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Fire-  
Extinguishing  
Systems**

**Sec. 807.** Automatic fire-extinguishing systems, standpipes, and basement pipe inlets shall be installed as specified in Chapter 38.

**Special  
Hazards**

**Sec. 808.** Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Each building shall be provided with an approved outside gas shut-off valve conspicuously marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a central heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

**EXCEPTION:** Where boilers and central heating plants burning liquid or solid fuel are located at grade level, they may be separated from the remainder of the building by a "One-Hour Fire-Resistive Occupancy Separation."

No flammable liquids shall be placed, stored, or used in any Group C occupancies, except in approved quantities as

necessary in laboratories and approved utility rooms, and such liquids shall be kept in tight or sealed containers when not in actual use.

**Sec. 809.** For requirements for gymnasiums and similar buildings, see Section 709. **Exceptions and**

Roof covering shall be a "fire-retardant" roofing as specified in Section 3203. **Deviations**

A building which will have only the first floor accessible to not more than 20 pupils at any time, may be used for school purposes with the following exceptions to Code requirements:

1. Exterior walls or parts of walls which are less than three feet (3') from adjacent property lines shall have no openings therein and shall be of not less than one-hour fire-resistive construction as specified in Chapter 43.
2. Classrooms may have only one exit not less than two feet six inches (2'6") wide.

## CHAPTER 9—REQUIREMENTS FOR GROUP D OCCUPANCIES

### Group D Occupancies Defined

**Sec. 901.** Group D Occupancies shall be:

**Division 1.** Mental hospitals, jails, prisons, reformatories, and buildings where personal liberties of inmates are similarly restrained.

**Division 2.** Nurseries for the full-time care of children under kindergarten age (each accommodating more than six persons).

Hospitals, sanitariums, mental sanitariums conforming to Section 3319 (g), and similar buildings (each accommodating more than six persons).

**Division 3.** Homes for the aged and homes for children of kindergarten age and older (each accommodating more than six persons).

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

### Construction, Height, and Area Allowable

**Sec. 902. (a) General.** Buildings or parts of buildings classed in Group D because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**(b) Special Provisions.** Division 1 occupancies shall be of Type I or II construction throughout. Occupancies in which the personal liberties of inmates or patients are restrained within the building shall have floors of incombustible construction.

Division 2 and 3 occupancies shall be one-hour fire-resistive construction throughout. Division 2 occupancies more than one story in height and Division 3 occupancies more than two stories in height shall be of Type I or II construction.

For attic space partitions and draft stops, see Section 3205.

### Location on Property

**Sec. 903.** For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

### Exit Facilities

**Sec. 904.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

### Light, Ventilation, and Sanitation

**Sec. 905.** All portions of Group D occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area equal to one-eighth of the total floor area, one-half of which shall be openable, or shall be provided with artificial light and a mechanically operated ventilating system as specified in Section 605.

For requirements for floors and walls of toilet compartments see Section 1711.

**Sec. 906.** Exits shall be enclosed as specified in Chapter 33.

**Enclosure  
of Vertical  
Openings**

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Sec. 907.** Automatic fire-extinguishing systems, standpipes, and basement pipe inlets shall be installed as specified in Chapter 38.

**Fire-  
Extinguishing  
Systems**

**Sec. 908.** Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

**Special  
Hazards**

Motion picture machine booths shall conform to the requirements of Chapter 40.

Storage of volatile flammable liquids shall not be allowed in Group D occupancies and the handling of such liquid shall not be permitted in any Group D occupancies in quantities of more than one gallon unless such handling complies with U.B.C. Standard No. 9-1.

Each building shall be provided with an approved outside gas shut-off valve conspicuously marked.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation."

**EXCEPTION:** Where boilers and central heating plants burning liquid or solid fuel are located at grade level, they may be separated from the remainder of the building by a "One-Hour Fire-Resistive Occupancy Separation."

## CHAPTER 10—REQUIREMENTS FOR GROUP E OCCUPANCIES

### Group E Occupancies Defined

**Sec. 1001.** Group E Occupancies shall be:

**Division 1.** Storage and handling of hazardous and highly flammable or explosive materials other than flammable liquids.

**Division 2.** Storage and handling of Class I, II, and III flammable liquids, as set forth in U.B.C. Standard No. 9-1; dry-cleaning plants using flammable liquids, paint stores with bulk handling; paint shops and spray painting rooms and shops.

**Division 3.** Woodworking establishments, planing mills and box factories; shops, factories where loose, combustible fibers or dust is manufactured, processed or generated; warehouses where highly combustible material is stored.

**Division 4.** Repair garages.

**Division 5.** Aircraft repair hangars.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

**Note:** Highly flammable liquids shall be deemed to be those with a flash point below 190 degrees Fahrenheit as determined by the closed cup tester, provided that liquids with a flash point above 138.5 degrees Fahrenheit shall not be deemed to be highly flammable when used in a closed safety cleaning system meeting the requirements of U. B. C. Standard No. 10-1 for a Class III rating.

### Construction, Height, and Area Allowable

**Sec. 1002. (a) General.** Buildings or parts of buildings classed in Group E because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**(b) Special Provisions.** Division 5 occupancies shall have exterior walls of not less than one-hour fire-resistive construction or shall be surrounded by public space, streets, or yards, not less than sixty feet (60') in width.

The area increases allowed by Section 506 (d) shall not exceed 500 per cent for aircraft repair hangars.

In public garages and where flammable or explosive liquids are used or stored floors shall be entirely protected with incombustible materials against saturation.

In buildings over ninety-five feet (95') in height, the structural frame shall be protected with not less than four-hour fire-resistive protection and the floors shall be of not less than three-hour fire-resistive construction.

For attic space partitions and draft stops see Section 3205.

### Location on Property

**Sec. 1003.** For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

**Sec. 1004.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

**Exit  
Facilities**

Where ramps are used for the transfer of automobiles from one floor to another such ramps shall meet the ground floor level at a point not less than twenty feet (20') from the exit from such building.

**Sec. 1005.** All portions of Group E occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area equal to one-eighth of the total floor area, one-half of which shall be openable, or shall be provided with artificial light and a mechanically operated ventilating system as specified in Section 605.

**Light,  
Ventilation,  
and  
Sanitation**

In all buildings used for the storing or handling of automobiles operated under their own power, and in all buildings where flammable liquids are used, exhaust ventilation shall be provided sufficient to produce one complete change of air every 15 minutes. Such exhaust ventilation shall be taken from a point at or near the floor level.

**EXCEPTION:** In public garages and aircraft hangars not exceeding an area of five thousand square feet (5000 sq. ft.), the Building Official may authorize the omission of such ventilating equipment where, in his opinion, the building is supplied with unobstructed openings to the outer air which are sufficient to provide the necessary ventilation.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

For requirements for floors and walls of toilet compartments, see Section 1711.

**Sec. 1006.** Exits shall be enclosed as specified in Chapter 33. Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Enclosure  
of Vertical  
Openings**

Doors which are part of an automobile ramp enclosure may be kept normally open but shall be equipped with fusible links and so arranged as to be self-closing when released.

**Sec. 1007.** Automatic fire-extinguishing systems, standpipes, and basement pipe inlets shall be installed as specified in Chapter 38.

**Fire-  
Extinguishing  
Systems**

**Sec. 1008.** Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

**Special  
Hazards**

In any room in which volatile flammable liquids are used or stored no device generating a glow or flame capable of igniting gasoline vapor shall be installed or used within twenty-four inches (24") of the floor.

**Special  
Hazards  
(Cont'd.)**

The use, handling, storage, and sale of gasoline, fuel oil, and other flammable liquids shall not be permitted in any Group E occupancy unless such use, handling, storage, and sale comply with U. B. C. Standard No. 9-1.

Dry cleaning plants in which highly flammable solvents are used or stored shall be of Type I construction and shall not exceed one story in height. All partitions shall be of four-hour fire-resistive construction, except for the necessary openings for the vent ducts, piping, and shafting. All openings in exterior walls, except wall vents, shall be protected by Class "E" or "F" fire doors or windows. Wall vents having an area of not less than sixteen square inches (16 sq. in.) each, shall be placed in the exterior walls near the floor line, not more than six feet (6') apart horizontally. Each building shall be provided with a power-driven fan exhaust system of ventilation which shall be arranged and operated so as to produce a complete change of air in each room every three minutes.

Each machine in dry cleaning establishments which uses a volatile flammable liquid shall have an adequate steam line directly connected to it, so arranged as to have the steam automatically released to the inside of such machine should an explosion occur in the machine.

Equipment or machinery which generates or emits combustible or explosive dust or fibers shall be provided with an adequate dust collecting and exhaust system installed in conformance with U.B.C. Standard No. 10-2, unless the building or portion thereof housing such machinery is provided with an automatic fire-extinguishing system conforming to the provisions of Chapter 38. The fire-extinguishing system for such occupancies having a floor area of less than three thousand square feet (3,000 sq. ft.) may be a type conforming to the provisions of Exception 2, Section 3802.



## CHAPTER 11—REQUIREMENTS FOR GROUP F OCCUPANCIES

**Sec. 1101.** Group F Occupancies shall be:

**Group F  
Occupancies  
Defined**

**Division 1.** Gasoline service stations, storage garages where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.

**Division 2.** Wholesale and retail stores, office buildings, restaurants, undertaking parlors, printing plants, municipal police and fire stations, factories and workshops using materials not highly flammable or combustible, storage and sales rooms for combustible goods, paint stores without bulk handling.

**Division 3.** Aircraft hangars where no repair work is done except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids. Open parking garages.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

**Sec. 1102. (a) General.** Buildings or parts of buildings classed in Group F because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**Construction,  
Height,  
and Area  
Allowable**

**(b) Special Provisions.** Motor vehicle service stations shall be of incombustible or one-hour fire-resistive construction, including canopies and supports over pumps.

In storage garages, floors shall be entirely protected against saturation.

Storage areas in excess of one thousand square feet (1,000 sq. ft.), in connection with wholesale or retail sales, shall be separated from the public areas by a one-hour fire-resistive occupancy separation.

For attic space partitions and draft stops see Section 3205.

**Sec. 1103.** For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

**Location on  
Property**

**Sec. 1104.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.

**Exit  
Facilities**

**Sec. 1105.** All portions of Group F occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area not less than one-eighth of the total floor area or shall be provided with artificial light and a mechanically operated ventilating system. In no case shall less than two changes of air per hour be provided.

**Light,  
Ventilation,  
and  
Sanitation**

**Light,  
Ventilation,  
and  
Sanitation  
(Cont'd.)**

In all buildings used for the storing or handling of automobiles operated under their own power, and in all buildings where flammable liquids are used, exhaust ventilation shall be provided sufficient to produce one complete change of air every 15 minutes. Such exhaust ventilation shall be taken from a point at or near the floor level.

**EXCEPTION:** In public garages and aircraft hangars not exceeding an area of five thousand square feet (5000 sq. ft.), the Building Official may authorize the omission of such ventilating equipment where, in his opinion, the building is supplied with unobstructed openings to the outer air which are sufficient to provide the necessary ventilation.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

Such toilet rooms in connection with food establishments where food is prepared, stored, or served, shall have a non-absorbent interior finish on floors, walls, and ceilings, shall be separated from such food establishments with close-fitting, tight doors with a vestibule between, shall have hand washing facilities therein or adjacent thereto. All toilet rooms shall be provided with an exterior window at least three square feet (3 sq. ft.) in area, fully openable, or a vertical duct not less than forty-eight square inches (48 sq. in.) in area, leading to the exterior in the building.

For requirements for floors and walls of toilet compartments, see Section 1711.

**Enclosure  
of Vertical  
Openings**

Sec. 1106. Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Fire-  
Extinguishing  
Systems**

Sec. 1107. Automatic fire-extinguishing systems, stand-pipes, and basement pipe inlets shall be installed as specified in Chapter 38.

**Special  
Hazards**

Sec. 1108. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

No storage of volatile flammable liquids shall be allowed in Group F occupancies and the handling and use of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group F occupancy unless such use and handling comply with U. B. C. Standard No. 9-1.

Devices generating a glow or flame capable of igniting gasoline vapor shall not be installed or used within twenty-four inches (24") of the floor in any room in which volatile flammable liquids are used or stored.

**Sec. 1109. (a) Scope.** Except where specific provisions are made in the following Subsections, other requirements of this Code shall apply.

**Open  
Parking  
Garages**

(b) **Definition.** For the purpose of this Section, an open parking garage is a structure of Type I, II, or IV construction more than one tier in height which is at least 50 per cent open on two or more sides and is used exclusively for the parking or storage of passenger motor vehicles having a capacity of not more than nine persons per vehicle.

(c) **Construction.** Construction shall be of incombustible materials. Open parking garages shall meet the design requirements of Chapter 23. Adequate curbs and railings shall be provided at every opening.

(d) **Area and Height.** Area and height of open parking garages in Fire Zones Nos. 1, 2, and 3 shall be limited as set forth in Table No. 11-A except for increases allowed by Subsection (e).

(e) **Area and Height Increases.** Area of structures open on three sides may be increased 25 per cent and one tier in height. Areas of structures open on four sides may be increased 50 per cent and one tier in height.

(f) **Location on Property.** Open parking garages shall have exterior walls without openings of the degree of fire resistance set forth in Table No. 11-B if located adjacent to interior property lines.

(g) **Stairs and Exits.** Where persons other than parking attendants are permitted, stairs and exits shall meet the requirements of Chapter 33, based on an occupant load of two hundred square feet (200 sq. ft.) per occupant. Where no persons other than parking attendants are permitted there shall be not less than two stairs three feet (3') wide. Lifts

**TABLE NO. 11-A—OPEN PARKING GARAGES  
AREA AND HEIGHT**

| TYPE                | AREA            | HEIGHT             |
|---------------------|-----------------|--------------------|
| Type I              | Unlimited       | Unlimited          |
| Type II             | 75,000 per tier | 7 stories, 8 tiers |
| Type IV—one-hour    | 50,000 per tier | 5 stories, 6 tiers |
| Type IV—unprotected | 30,000 per tier | 3 stories, 4 tiers |

**TABLE NO. 11-B—OPEN PARKING GARAGES  
EXTERIOR WALLS**

| DISTANCE FROM<br>PROPERTY LINE<br>TO BUILDING | FIRE ZONE<br>NO. 1 | FIRE ZONE<br>NO. 2 | FIRE ZONE<br>NO. 3 |
|---|--------------------|--------------------|--------------------|
| 0'-10'  | 2-hour             | 2-hour             | 1-hour             |
| 10'-20'                                       | 1-hour             | 1-hour             | None               |

**Open  
Parking  
Garages  
Cont'd.)**

may be installed for use of employees only, provided they are completely enclosed by incombustible materials.

(h) **Standpipes.** Standpipes shall not be required.

(i) **Occupancy Separations.** Occupancy separations shall be installed as required in Chapter 5 between open parking garages and other occupancy such as sale of gasoline or oil.

(j) **Fire-Extinguishing Apparatus.** At each stair and lift opening on each tier there shall be provided one hand fire extinguisher of a size and content approved by the Fire Chief. Automatic fire-extinguishing systems shall be installed as specified in Chapter 38.

(k) **Enclosure of Vertical Openings.** Enclosure shall not be required for vertical openings except as specified in Subsection (g) for stairs, exits, and lifts.

(l) **Ventilation.** Ventilation, other than the percentage of openings specified in Subsection (b), shall not be required.

(m) **Prohibitions.** The following uses and alterations are not permitted:

1. Automobile repair work.
2. Sale of gasoline or oil.
3. Parking of busses, trucks, and similar vehicles.
4. Partial or complete closing of required openings in exterior walls by tarpaulins or any other means.

## CHAPTER 12—REQUIREMENTS FOR GROUP G OCCUPANCIES

- Sec. 1201.** Group G Occupancies shall be:
- Group G  
Occupancies  
Defined**
- Ice plants, power plants, pumping plants, cold storage, creameries.
- Factories and workshops using incombustible and nonexplosive materials.
- Storage and sales rooms of incombustible and nonexplosive materials.
- For occupancy separations see Table No. 5-B.
- For occupant load see Section 3301.
- Sec. 1202.** (a) **General.** Buildings or parts of buildings classed in Group G because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.
- Construction,  
Height,  
and Area  
Allowable**
- (b) **Special Provisions.** Fire protection of the under side of roof framing may be omitted in all Types of Construction.
- For attic space partitions and draft stops see Section 3205.
- Sec. 1203.** For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.
- Location on  
Property**
- Sec. 1204.** Stairs, exits, and smokeproof enclosures shall be provided as specified in Chapter 33.
- Exit  
Facilities**
- Sec. 1205.** All portions of Group G occupancies customarily used by human beings shall be provided with light and ventilation as specified in Section 1105.
- Light,  
Ventilation,  
and  
Sanitation**
- Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.
- For requirements for floors and walls of toilet compartments, see Section 1711.
- Sec. 1206.** Exits shall be enclosed as specified in Chapter 33. Other vertical openings are not required to be enclosed.
- Enclosure  
of Vertical  
Openings**
- Sec. 1207.** Automatic fire-extinguishing systems, standpipes, and basement pipe inlets shall be installed as specified in Chapter 38.
- Fire-  
Extinguishing  
Systems**
- Sec. 1208.** Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.
- Special  
Hazards**

**Special  
Hazards  
(Cont'd.)**

In any room in which volatile flammable liquids are used or stored, no device generating a glow or flame capable of igniting gasoline vapor shall be installed or used within twenty-four inches (24") of the floor.

The storage, use, and handling of gasoline, fuel oil, and other flammable liquids shall not be permitted in any Group G occupancy unless such storage, use, and handling comply with U. B. C. Standard No. 9-1.

)

## CHAPTER 13—REQUIREMENTS FOR GROUP H OCCUPANCIES

**Sec. 1301.** Group H Occupancies shall be:  
Hotels, apartment houses, dormitories, lodging houses.  
Convents and monasteries (each accommodating more than 10 persons).  
For occupancy separations see Table No. 5-B.  
For occupant load see Section 3301.

**Group H  
Occupancies  
Defined**

**Sec. 1302. (a) General.** Buildings or parts of buildings classed in Group H because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**Construction,  
Height,  
and Area  
Allowable**

**(b) Special Provisions.** Group H occupancies more than two stories in height or having more than three thousand square feet (3,000 sq. ft.) of floor area above the first floor shall be of not less than one-hour fire-resistive construction throughout.

For attic space partitions and draft stops see Section 3205.

**Sec. 1303.** For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

**Location on  
Property**

**Sec. 1304.** Stairs, exits, and smokeproof enclosures shall be as specified in Chapter 33.

**Exit  
Facilities**

All stairs and exits in Group H occupancies shall open directly upon a street or alley or upon a yard or court not less than four feet (4') in width directly connected to a street or alley by means of a passageway not less in width than the stairway opening into such passageway and not less than seven feet (7') in height.

Buildings more than one story in height shall have no transoms or ventilating openings from guest rooms to public corridors.

Doors opening from guest rooms into public corridors shall be incombustible or of wood not less than one and three-eighths inches ( $1\frac{3}{8}$ ") thick at any point.

**Sec. 1305. (a) Windows.** All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows with an area not less than twelve square feet (12 sq. ft.) nor one-eighth of the floor area of such rooms. The window area in bathrooms, water-closet compartments, and other similar rooms shall be not less than three square feet (3 sq. ft.), unless adequate mechanical ventilation is provided. Not less than one-half such area shall be openable.

**Light,  
Ventilation,  
and  
Sanitation**

Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear

**Light,  
Ventilation,  
and  
Sanitation  
(Cont'd.)**

height of not less than seven feet (7') and a depth of not more than seven feet (7'). Such porch shall be at least 50 per cent open on at least two sides.

The width of such courts or yards shall be not less than three feet (3') when such courts or yards are not more than two stories high measured down from the top of the building and shall be increased at the rate of six inches (6") for each additional story in height. If such court is entirely surrounded by the building, it shall have a width at least 50 per cent greater than that otherwise required.

(b) **Room Sizes and Ceiling Heights.** Every room required to have windows by Subsection (a) shall have a ceiling height of eight feet (8') in at least 50 per cent of its area. Rooms used for living, eating, or sleeping purposes shall have an area of not less than eighty square feet (80 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

(c) **Sanitation.** Every building shall be provided with at least one toilet. Every hotel and each subdivision thereof where both sexes are accommodated shall be provided with at least two toilets located in such building, which shall be conspicuously marked, one for each sex. Not less than one toilet shall be provided for each 15 persons or major fraction thereof that such building is designed to accommodate.

One toilet shall be provided for each apartment.

For requirements for floors and walls of toilet compartments, see Section 1711.

A kitchen sink shall be installed in every kitchen.

**Enclosure  
of Vertical  
Openings**

**Sec. 1306.** Exits shall be enclosed as specified in Chapter 33.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Fire-  
Extinguishing  
Systems**

**Sec. 1307.** Automatic fire-extinguishing systems, stand-pipes, and basement pipe inlets shall be installed as specified in Chapter 38.

**Special  
Hazards**

**Sec. 1308.** Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

The storage and handling of gasoline, fuel oil, and other flammable liquids shall not be permitted in any Group H occupancy unless such storage and handling comply with U. B. C. Standard No. 9-1.

Doors leading into rooms in which volatile flammable liquids are used or kept shall be protected by Class "C" fire doors and shall be kept normally closed.

Every boiler room or room containing a central heating plant using solid or liquid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation."



**EXCEPTIONS:** 1. Such furnaces may be used without **Special**  
a "Fire-Resistive Occupancy Separation" in buildings not **Hazards**  
more than two stories in height. **(Cont'd.)**

2. In buildings of Type V construction a "One-Hour  
Fire-Resistive Occupancy Separation" may be used.

**Sec. 1309.** For existing buildings see Appendix Section 1309. **Existing  
Buildings**

## CHAPTER 14—REQUIREMENTS FOR GROUP I OCCUPANCIES

**Group I  
Occupancies  
Defined**

**Sec. 1401.** Group I Occupancies shall be:

Dwellings.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

**Construction,  
Height,  
and Area  
Allowable**

**Sec. 1402.** Buildings or parts of buildings classed in Group I because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**Location on  
Property**

**Sec. 1403.** For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

**Exit  
Facilities**

**Sec. 1404.** Stairs and exits shall be provided as specified in Chapter 33.

**Light,  
Ventilation,  
and  
Sanitation**

**Sec. 1405.** (a) **Windows.** All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows with an area not less than twelve square feet (12 sq. ft.) nor one-eighth of the floor area of such room. Not less than one-half such area shall be openable.

The window area in bathrooms, water-closet compartments, and other similar rooms shall be not less than three square feet (3 sq. ft.), and may open on a vent shaft which has a least dimension open and unobstructed to the sky of not less than three feet (3'). In lieu of the foregoing requirements a mechanical ventilating system to the outside air may be installed.

Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear height of not less than seven feet (7'). Such porch shall be at least 50 per cent open on at least one side.

(b) **Room Sizes and Ceiling Heights.** Every room required to have windows by Subsection (a) shall have a ceiling height of not less than seven feet six inches (7' 6") in at least 50 per cent of its required area with no portion less than five feet (5') in height. Rooms used for living, eating, or sleeping purposes shall have an area of not less than eighty square feet (80 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

(c) **Sanitation.** There shall be no opening from a room in which a water closet is located into a room in which food is prepared or stored.

**Enclosure  
of Vertical  
Openings**

**Sec. 1406.** Dumb-waiter shafts, clothes chutes, and other vertical openings shall be enclosed and the enclosure shall be as set forth in Table No. 17-A. (See also Chapter 30.)

**Sec. 1407.** Fire-extinguishing systems when installed shall conform to the requirements of Chapter 38.

**Fire-  
Extinguishing  
Systems**

**Sec. 1408.** Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

**Special  
Hazards**

Flammable liquids shall not be stored or used in Group I occupancies in quantities in excess of one gallon and all such flammable liquids shall be kept in tight or sealed containers when not in actual use.

**Sec. 1409.** Group I occupancies constructed on the roof of multiple-storied buildings shall be considered as an additional story in so far as the construction, location, exposure, stairs, exits, and fire-extinguishing apparatus are concerned.

**Exceptions  
and  
Deviations**

A carport open on two or more sides need not have a fire separation between the carport and the dwelling.

Windows between the carport and the dwelling shall not be openable. Doors may be of any type, provided that any sash used in a door be fixed; doors between a dwelling and a carport shall be self-closing.

**Sec. 1410.** The following are the minimum requirements which shall be completed and approved before occupancy is permitted or utilities connected:

**Minimum  
Occupancy  
Requirements**

1. Foundation, framing, roof covering, and exterior wall covering.
2. Kitchen and bathroom separated by partitions, ceilings, and doors.
3. Water closet, kitchen sink, and sewage-disposal system installed when required.

## CHAPTER 15—REQUIREMENTS FOR GROUP J OCCUPANCIES

### Group J Occupancies Defined

Sec. 1501. Group J Occupancies shall be:

**Division 1.** Private garages, sheds, and agricultural buildings when not over one thousand square feet (1000 sq. ft.) in area.

**Division 2.** Fences over six feet (6') high, tanks, and towers.

For occupancy separations see Table No. 5-B.

For occupant load see Section 3301.

### Construction, Height, and Area Allowable

Sec. 1502. Buildings or parts of buildings classed in Group J because of the use or character of the occupancy shall be one of the Types of Construction as specified in Part V of this Code. The floor area shall not exceed one thousand square feet (1000 sq. ft.). The height shall not exceed one story.

When any building exceeds the limit specified in this Chapter it shall be classed in the occupancy group other than Group J that it most nearly resembles.

### Location on Property

Sec. 1503. For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

### Light and Ventilation

Sec. 1504. Private garages which are constructed in conjunction with any Group H or I occupancies and which have openings into such buildings shall be equipped with fixed louvered or screened openings or exhaust ventilation with exhaust openings located within six inches (6") of the floor. The clear area of the louvered opening or of the openings into the exhaust ducts shall be not less than sixty square inches (60 sq. in.) per car stored in such private garage. Under no circumstances shall a private garage have any opening directly into a room used for sleeping purposes.

### Special Hazards

Sec. 1505. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Flammable liquids shall not be stored, handled, or used in Group J occupancies unless such storage or handling shall comply with U. B. C. Standard No. 9-1.

## PART IV

### REQUIREMENTS BASED ON LOCATION IN FIRE ZONES

#### CHAPTER 16—RESTRICTIONS IN FIRE ZONES

**Sec. 1601. (a) Fire Zones Defined.** For the purpose of **General** this Code, the entire city is hereby declared to be and is hereby established a Fire District and said Fire District shall be known and designated as Fire Zones One, Two, and Three, and shall include such territory or portions of said City as outlined in an ordinance of said City, entitled: "An Ordinance Creating and Establishing Fire Zones." Whenever in this Code reference is made to any fire zone, it shall be construed to mean one of the fire zones created by said ordinance.

**(b) Buildings Located in More than One Fire Zone.** A building or structure which is located partly in one fire zone and partly in another shall be considered to be in the more highly restricted fire zone when more than one-third of its total floor area is located in such zone.

**(c) Moved Buildings.** Any building or structure moved within or into any fire zone shall be made to comply with all the requirements for new buildings in that fire zone.

**(d) Temporary Buildings.** Temporary buildings such as reviewing stands and other miscellaneous structures conforming to the requirements of this Code, and sheds, canopies, or fences used for the protection of the public around and in conjunction with construction work may be erected in Fire Zones No. 1 or 2 by special permit from the Building Official for a limited period of time, and such building or structure shall be completely removed upon the expiration of the time limit stated in such permit.

**(e) Center Lines of Streets.** For the purpose of this Chapter, the center line of an adjoining street or alley may be considered an adjacent property line. Distance shall be measured at right angles to the street or alley.

**Sec. 1602. (a) General.** Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 1 shall be only of Type I, II, III-H.T., III-1-hour, or IV-1-hour construction and shall meet the requirements of this Section. **Restrictions in Fire Zone No. 1**

**EXCEPTION:** Unprotected Type IV buildings not more than one story in height nor more than twenty-five hundred square feet (2500 sq. ft.) in area shall be permitted if the exterior walls are twenty feet (20') or more from adjacent property lines.

**(b) Alterations.** No building of Type IV construction in excess of one thousand square feet (1000 sq. ft.) in floor area

**Restrictions  
in Fire Zone  
No. 1  
(Cont'd.)**

nor any building of Type V construction already erected in Fire Zone No. 1 shall hereafter be altered, raised, enlarged, added to, or moved, except as follows:

1. Such Type IV building may be made to conform to all the provisions of Sections 1602 (a) and 2103.

2. Changes, alterations, and repairs to the interior of such building or to the front thereof facing a public street may be made, provided such changes do not, in the opinion of the Building Official, increase the fire hazard of such building.

3. Roofs of such buildings may be covered only with a "fire-retardant" roofing as specified in Section 3204. See Section 104 (f) for repairs.

4. Such building may be moved entirely outside the limits of Fire Zone No. 1.

5. Such building may be demolished.

(c) **Occupancies Prohibited.** No Group E, Division 2 occupancy having a floor area exceeding fifteen hundred square feet (1500 sq. ft.) shall be permitted in Fire Zone No. 1.

No Group E, Division 1 or 5 occupancies shall be permitted in Fire Zone No. 1.

**EXCEPTION:** This shall not apply to dry cleaning plants not using highly flammable liquids.

**Restrictions  
in Fire Zone  
No. 2**

**Sec. 1603. (a) General.** Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 2 shall be one of the Types of Construction as defined in this Code and shall meet the requirements of this Section.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Part V.

(b) **Alterations.** No building of Type IV construction in excess of one thousand square feet (1000 sq. ft.) in floor area nor any building of Type V construction already erected in Fire Zone No. 2, shall hereafter be altered, raised, enlarged, added to or moved except as follows:

1. Such building may be made to conform to the provisions of Section 2103 for Type IV and Section 2203 for Type V construction.

2. Changes, alterations, and repairs to the interior of such building or to the front thereof facing a public street may be made provided such changes do not, in the opinion of the Building Official, increase the fire hazard of such building.

3. Roofs of such buildings may be covered only with a "fire-retardant" roofing as specified in Section 3204. See Section 104 (f) for repairs.

4. Such building may be moved entirely outside the limits of Fire Zone No. 2.

5. Such building may be demolished.

6. Combustible finish on the outside of walls may be replaced by or covered with exterior plaster as specified in Chapter 47.

(c) **Occupancies Prohibited.** No Group E, Division 2 occupancy having a floor area exceeding fifteen hundred square feet (1500 sq. ft.) shall be permitted in Fire Zone No. 2.

No Group E, Division 1 or 5 occupancies shall be permitted in Fire Zone No. 2.

**EXCEPTION:** This shall not apply to dry cleaning plants not using highly flammable liquids.

Sec. 1604. Any building or structure complying with the requirements of this Code may be erected, constructed, moved within or into Fire Zone No. 3.

**Restrictions  
in Fire Zone  
No. 3**

## PART V

### REQUIREMENTS BASED ON TYPES OF CONSTRUCTION

#### CHAPTER 17—CLASSIFICATION OF ALL BUILDINGS BY TYPES OF CONSTRUCTION AND GENERAL REQUIREMENTS

**General**

**Sec. 1701.** The requirements of Part V are for the various Types of Construction and represent varying degrees of public safety and resistance to fire. Every building shall be classified by the Building Official into one of the Types of Construction set forth in Table No. 17-A. Any building which does not entirely conform to a Type of Construction set forth in Table No. 17-A shall be classified by the Building Official into a type having an equal or lesser degree of fire resistance.

No building or portion thereof shall be required to conform to the details of a Type of Construction higher than that type which meets the minimum requirements based on Occupancy (Part III) or Location in Fire Zone (Part IV) even though certain features of such building actually conform to a higher Type of Construction.

Where specific materials, types of construction, or fire-resistive protection are required, such requirements shall be the minimum requirements and any materials, types of construction, or fire-resistive protection which will afford equal or greater public safety or resistance to fire, as specified in this Code, may be used.

Portions of buildings separated as specified in Section 505 (c) may be considered a separate building for classification of types of construction. When there is no such separation, the area of the entire building shall not exceed the least area permitted for the types of construction involved.

**Structural  
Frame**

**Sec. 1702.** The structural frame shall be considered to be the columns and the girders, beams, trusses, and spandrels having direct connections to the columns and all other members which are essential to the stability of the building as a whole. The members of floor or roof panels which have no connection to the columns shall be considered secondary members and not a part of the structural frame.

**Usable Space  
Under Floors**

**Sec. 1703.** Usable space under the first floor shall be enclosed except in Group I and J occupancies and such enclosure when constructed of metal or wood shall be protected on the side of the usable space as required for one-hour fire-resistive construction. Doors shall be self-closing incombustible or solid-core wood not less than one and three-eighths inches ( $1\frac{3}{8}$ " ) in thickness.



**Sec. 1704.** Roof covering shall be "fire-retardant" except **Roof Coverings** in Type V buildings housing Groups H, I, or J occupancies, where it may be "ordinary," as specified in Section 3203 (f). Skylights shall be constructed as required in Chapter 34. Penthouses shall be constructed as required in Chapter 36.

**Sec. 1705. (a) Partitions.** Regardless of the fire-resistive requirements for permanent partitions, temporary partitions dividing portions of stores, offices, or similar places occupied by one tenant only, and which do not establish a public corridor, may be constructed of: **Unprotected Materials Allowed**

1. Incombustible materials
2. One-hour fire-resistive construction
3. Wood panels or similar light construction up to three-fourths the height of the room in which placed; when more than three-fourths the height of the room, such partitions shall have not less than the upper one-fourth of the partition constructed of glass.

**(b) Show Windows and Cases.** Show-window frames, aprons, show cases, and other appurtenances on the first floor of stores or other similar occupancies may be of wood or unprotected steel or iron.

**(c) Trim.** Trim, picture molds, chair rails, baseboards, handrails, show-window backing may be of wood. Unprotected wood doors and windows may be used except where openings are required to be fire protected.

Materials used for interior finish of walls and ceilings, including wainscoting, shall be as specified in Chapter 42.

**(d) Loading Platforms.** Exterior loading platforms may be of incombustible construction or heavy timber construction with wood floors not less than two inches (2") nominal thickness. Such wood construction shall not be carried through the exterior walls.

**(e) Insulating Boards.** Combustible insulating boards may be used under finished flooring.

**Sec. 1706. (a) General.** Enclosures for elevator shafts, vent shafts, and other vertical openings shall be as set forth in Table No. 17-A and all openings therein shall be protected by Class "E" or "F" fire doors for exterior openings and Class "B" doors for interior openings. (See Chapter 30.) **Enclosure of Vertical Openings**

**EXCEPTION:** In Type V buildings, chutes and dumb-waiter shafts with a cross-sectional area of not more than nine square feet (9 sq. ft.) may be lined with approved incombustible materials covered with not less than 26 U. S. gauge sheet metal with all joints in such sheet metal lock-lapped. All openings into any such vertical enclosure shall be protected by metal or metal-clad doors with either metal or metal-clad jambs, casings, or frames.

**(b) Construction.** Exit enclosures shall be constructed as specified in Section 3308.

**(c) Guard Rail.** A parapet wall, or handrail, which is at least thirty-six inches (36") in height shall be provided around all open shaft enclosures extending through the roof.

**TABLE NO. 17-A—TYPES OF CONSTRUCTION—FIRE-RESISTIVE REQUIREMENTS**  
(In Hours)

(For Details see Chapters under Occupancy and Types of Construction)

| MATERIALS OF CONSTRUCTION  | I                             | II                            | III                           |                               | IV                        |               | V                         |                           |
|----------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|---------------------------|---------------|---------------------------|---------------------------|
|                            | Incom-<br>bustible            | Incom-<br>bustible            | 1-Hr. or H.T.                 | N                             | 1-Hour                    | N             | 1-Hour                    | N                         |
|                            |                               |                               | Combustible                   |                               | Incombustible             |               | Combustible               |                           |
| Ext. Bearing Walls         | <sup>4</sup><br>Sec. 1803 (a) | <sup>4</sup><br>Sec. 1903 (a) | <sup>4</sup><br>Sec. 2003 (a) | <sup>4</sup><br>Sec. 2003 (a) | 1                         | N             | 1                         | N                         |
| Int. Bearing Walls         | 3                             | 1                             | 1                             | N                             | 1                         | N             | 1                         | N                         |
| Ext. Non-Bearing Walls     | <sup>4</sup><br>Sec. 1803 (a) | <sup>4</sup><br>Sec. 1903 (a) | <sup>4</sup><br>Sec. 2003 (a) | <sup>4</sup><br>Sec. 2003 (a) | 1                         | N             | 1                         | N                         |
| Structural Frame           | 3                             | 2                             | <sup>1</sup> or<br>H.T.       | N                             | 1                         | N             | 1                         | N                         |
| Partitions—Perm.           | 1                             | 1                             | <sup>1</sup> or<br>H.T.       | N                             | 1                         | N             | 1                         | N                         |
| Vertical Openings          | 2                             | 2                             | <sup>1</sup> or<br>H.T.       | 1                             | 1                         | 1             | <sup>1</sup><br>Sec. 1706 | <sup>1</sup><br>Sec. 1706 |
| Floors                     | 2                             | 1                             | <sup>1</sup> or<br>H.T.       | N                             | 1                         | N             | 1                         | N                         |
| Roofs                      | <sup>2</sup><br>Sec. 1806     | <sup>1</sup><br>Sec. 1906     | <sup>1</sup> or<br>H.T.       | N                             | <sup>1</sup><br>Sec. 2106 | N             | 1                         | N                         |
| Exterior Doors and Windows | Sec. 1803 (b)                 | Sec. 1903 (b)                 | Sec. 2003 (b)                 | Sec. 2003 (b)                 | Sec. 2103 (b)             | Sec. 2103 (b) | Sec. 2203 (b)             | Sec. 2203 (b)             |
| Inner Court Walls          | <sup>3</sup><br>Sec. 1803 (a) | <sup>2</sup><br>Sec. 1903 (a) | <sup>1</sup> or<br>H.T.       | 1                             | 1                         | N             | 1                         | N                         |

N—No general requirements for fire resistance. H.T.—Heavy Timber.

**Sec. 1707. (a) Building Paper.** Asphalt-saturated felt free from holes and breaks and weighing not less than 14 pounds per hundred square feet (100 sq. ft.) or approved waterproof paper, shall be applied over studs or sheathing of all exterior walls. Such felt or paper shall be applied weatherboard fashion, lapped not less than two inches (2") at horizontal joints and not less than six inches (6") at vertical joints. **Weather Protection**

Building paper may be omitted in the following cases:

1. When exterior covering is of approved weatherproof panels.
2. In back-plastered construction.
3. When there is no human occupancy.
4. Over water-repellent panel sheathing.

**(b) Flashing.** Exterior openings exposed to the weather shall be flashed with rust-resistive metal or other approved flashing in such a manner as to make them waterproof.

**Sec. 1708.** All members carrying masonry in buildings over one story in height shall be fire protected with not less than one-hour fire-protection. **Members Carrying Masonry**

**EXCEPTION:** Fire protection may be omitted from the bottom flange of lintels, shelf angles, or plates that are not a part of the structural frame.

**Sec. 1709.** Parapet walls not less than twelve inches (12") in height shall be provided on exterior walls of buildings when the walls are required to be fire-resistant due to their location on the property. **Parapets**

A parapet wall shall have the same fire resistance as required for the wall itself.

**EXCEPTIONS:** Parapets shall not be required on the following walls:

1. When the roof construction is entirely incombustible.
2. When the roof has an angle of more than 20 degrees with horizontal.
3. On buildings twenty feet (20') or less in height.

**Sec. 1710.** Except in Type V construction, cornices and similar appendages shall be constructed of substantial incombustible materials and when over public property as specified in Chapter 45. **Cornices**

**Sec. 1711.** The floors and walls of toilet compartments in A to H occupancies and those within two feet (2') of front and sides of urinals shall be finished with a smooth hard surface of cement, tile, or an approved equal. Walls shall be so finished to a height of four feet (4') above the floor. Each water-closet compartment shall be not less than thirty inches (30") in width. **Toilet Compartments**

**CHAPTER 18—TYPE I BUILDINGS****Definition**

**Sec. 1801.** The structural elements in Type I Buildings shall be of steel, iron, concrete, or masonry.

Walls and permanent partitions shall be of incombustible fire-resistive construction.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

**Structural Framework**

**Sec. 1802.** Structural framework shall be of structural steel or iron as specified in Chapter 27, reinforced concrete as in Chapter 26, or reinforced masonry as in Chapter 24.

For additional requirements for Group E occupancies, see Section 1002 (b).

**Exterior Walls and Openings**

**Sec. 1803. (a) Exterior Walls and Inner Court Walls.** Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 or thirty feet (30') in Fire Zones Nos. 2 and 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A.

**EXCEPTION:** 1. In Group F, G, and H occupancies exterior and inner court bearing walls may be two-hour fire-resistive where openings are permitted.

2. In other than Group E occupancies exterior and inner court non-bearing walls may be one-hour fire-resistive construction where unprotected openings are permitted and two-hour fire-resistive construction where fire protection of openings is required.

**(b) Openings in Walls.** Openings in exterior walls, including outer courts, shall be protected by either Class "E" or "F" fire doors or windows when:

1. They are less than twenty feet (20') from the adjacent property line.

2. They are in Fire Zone No. 1 and are less than fifty feet (50') from the opposite side of a public street or public place. The sum of the widths of such openings shall not exceed 50 per cent of the total length of a wall in each story.

3. They are in Fire Zones Nos. 2 or 3 and are less than thirty feet (30') from the opposite side of a public street or public way.

Openings in inner court walls of buildings over one story in height shall be protected by Class "E" or "F" fire doors or windows when the least dimension of the court is less than forty feet (40').

4. No openings shall be permitted in exterior walls of Group A, B, C, D, E, and F occupancies less than five feet (5') from the property line, and no openings in Group G, H,

I, and J occupancies less than three feet (3') from the property line.

**Sec. 1804. (a) Wood Sleepers.** Where wood sleepers are used for laying wood flooring on masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material in such a manner that there will be no open spaces under the flooring which will exceed one hundred square feet (100 sq. ft.) in area and such space shall be filled solidly under all permanent partitions so that there is no communication under the flooring between adjoining rooms. **Floors**

**(b) Mezzanine Floors.** Mezzanine floors may be of wood or unprotected steel except that in Fire Zone No. 1 they shall be of incombustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as specified for floors in Section 2514 (b).

Not more than two mezzanine floors shall be in any room of a building.

No mezzanine floor or floors shall cover more than 33⅓ per cent of the area of any room.

**Sec. 1805.** Stairs and stair platforms shall be constructed of reinforced concrete, iron, or steel with treads and risers of concrete, iron, or steel. Brick, marble, tile, or other hard incombustible materials may be used for the finish of such treads and risers. **Stair Construction**

Stairs shall be designed and constructed as specified in Chapter 33.

**Sec. 1806.** Roofs more than twenty-five feet (25') above any floor, balcony, or gallery may be of unprotected incombustible materials. **Roofs**

Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is not less than twenty-five feet (25') above any floor, balcony, or gallery, fire protection of all members of the roof construction may be omitted.

Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is more than eighteen feet (18') and less than twenty-five feet (25') above any floor, balcony, or gallery, the roof construction shall be protected by a ceiling of not less than one-hour fire-resistive construction.

Roofs may be sheathed by wood planks of two-and-one-half-inch (2½") nominal thickness when such sheathing is more than thirty feet (30') distant from any floor, balcony, or gallery and when such plank sheathing is protected on the underside by a ceiling of not less than one-hour fire-resistive construction.

**CHAPTER 19—TYPE II BUILDINGS****Definition**

**Sec. 1901.** The structural elements in Type II Buildings shall be of steel, iron, concrete, or masonry.

Walls and permanent partitions shall be of incombustible fire-resistive construction.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

**Structural Framework**

**Sec. 1902.** Structural framework shall be of structural steel or iron as specified in Chapter 27, reinforced concrete as in Chapter 26, or reinforced masonry as in Chapter 24.

**Exterior Walls and Openings**

**Sec. 1903. (a) Exterior Walls and Inner Court Walls.** Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 or thirty feet (30') in Fire Zones Nos. 2 and 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A.

**EXCEPTION:** 1. In Group F, G, and H occupancies exterior and inner court bearing walls may be of two-hour fire-resistive construction where openings are permitted.

2. In other than Group E occupancies exterior and inner court non-bearing walls may be of one-hour fire-resistive construction where unprotected openings are permitted and two-hour fire-resistive construction where fire protection of openings is required.

**(b) Openings in Walls.** Openings in exterior walls, including outer courts, shall be protected by either Class "E" or "F" fire doors or windows when:

1. They are less than twenty feet (20') from the adjacent property line.

2. They are in Fire Zone No. 1 and are less than fifty feet (50') from the opposite side of a public street or public place. The sum of the widths of such openings shall not exceed 50 per cent of the total length of a wall in each story.

3. They are in Fire Zones Nos. 2 or 3 and are less than thirty feet (30') from the opposite side of a public street or public way.

Openings in inner court walls of buildings over one story in height shall be protected by Class "E" or "F" fire doors or windows when the least dimension of the court is less than forty feet (40').

4. No openings shall be permitted in exterior walls of Group A, B, C, D, E, and F occupancies less than five feet (5') from the property line, and no openings in Group G, H, I, and J occupancies less than three feet (3') from the property line.

**Sec. 1904. (a) General.** Where wood sleepers are used for **Floors** laying wood flooring on masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material in such a manner that there will be no open spaces under the flooring which will exceed one hundred square feet (100 sq. ft.) in area and such space shall be filled solidly under all permanent partitions so that there is no communication under the flooring between adjoining rooms.

**(b) Mezzanine Floors.** Mezzanine floors may be of wood or unprotected steel except that in Fire Zone No. 1 they shall be of incombustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as specified for floors in Section 2514 (b).

Not more than two mezzanine floors shall be in any room of a building.

No mezzanine floor or floors shall cover more than 33½ per cent of the area of any room.

**Sec. 1905.** Stairs and stair platforms shall be constructed of reinforced concrete, iron, or steel with treads and risers of concrete, iron, or steel. Brick, marble, tile, or other hard incombustible materials may be used for the finish of such treads and risers. **Stair Construction**

Stairs shall be designed and constructed as specified in Chapter 33.

**Sec. 1906.** Roofs more than twenty-five feet (25') above any floor, balcony, or gallery may be of unprotected incombustible materials. **Roofs**

Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is not less than twenty-five feet (25') above any floor, balcony, or gallery, fire protection of all members of the roof construction may be omitted.

Where the structural steel framework of the roof of a Group A, B, or C occupancy is more than eighteen feet (18') and less than twenty-five feet (25') above any floor, balcony, or gallery, the roof construction shall be protected by a ceiling of not less than one-hour fire-resistive construction.

Roofs may be sheathed by wood planks of two-and-one-half-inch (2½") nominal thickness when such sheathing is more than thirty feet (30') distant from any floor, balcony, or gallery and when such plank sheathing is protected on the underside by a ceiling of not less than one-hour fire-resistive construction.

**CHAPTER 20—TYPE III BUILDINGS****Definition**

**Sec. 2001.** Structural elements of Type III Buildings may be of any materials permitted by this Code.

Type III, One-Hour buildings shall be one-hour fire-resistive construction throughout.

Type III, Heavy Timber buildings shall be Heavy Timber Construction as provided in Section 2514.

Exterior walls shall be of incombustible fire-resistive construction.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

For requirements due to occupancy, see Chapters 6 to 13, inclusive.

For requirements in Fire Zones see Chapter 16.

**Structural Framework**

**Sec. 2002.** Structural framework shall be of steel or iron as specified in Chapter 27, concrete as in Chapter 26, masonry as in Chapter 24, or wood as in Chapter 25 and this Chapter.

**Exterior Walls, Openings, and Partitions**

**Sec. 2003. (a) Exterior Walls and Inner Court Walls.** Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 or thirty feet (30') in Fire Zones Nos. 2 and 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A, with a minimum of one-hour fire protection.

**EXCEPTIONS:** 1. In Group F, G, and H occupancies exterior bearing walls may be of two-hour incombustible construction where openings are permitted.

2. In other than Group E occupancies exterior non-bearing walls may be of one-hour incombustible construction where unprotected openings are permitted and two-hour incombustible construction where fire protection of openings is required.

**(b) Openings in Walls.** Openings in exterior walls, including outer courts, shall be protected by either Class "E" or "F" fire doors or windows when:

1. They are less than twenty feet (20') from the adjacent property line.

2. They are in Fire Zone No. 1 and are less than fifty feet (50') from the opposite side of a public street or public place. The sum of the widths of such openings shall not exceed 50 per cent of the total length of a wall in each story.

3. They are in Fire Zones Nos. 2 or 3 and are less than thirty feet (30') from the opposite side of a public street or public way.

Openings in inner court walls of buildings over one story in height shall be protected by Class "E" or "F" fire doors



or windows when the least dimension of the court is less than forty feet (40').

**Exterior  
Walls,  
Openings, and  
Partitions  
(Cont'd.)**

4. No openings shall be permitted in exterior walls of Group A, B, C, D, E, and F occupancies less than five feet (5') from the property line, and no openings in Group G, H, I, and J occupancies less than three feet (3') from the property line.

(c) **Partitions.** Permanent partitions in Type III, One-Hour buildings shall be of one-hour fire-resistive construction. In Type III H.T. buildings they shall be of solid wood construction formed by not less than two layers of one-inch (1") nominal matched boards or laminated construction three and five-eighths inches (3 $\frac{5}{8}$ ") thick, or of one-hour fire-resistive construction. Bearing partitions when constructed of wood shall not support more than two stories and a roof. Partitions shall be constructed as specified in Section 2507 (e).

**Sec. 2004. (a) General.** Floors may be constructed as specified in Chapter 26 for concrete, Chapter 24 for masonry, Chapter 25 for wood, and Chapter 27 for steel or iron.

**Floors**

Wood joists, beams, and girders supported by masonry walls shall be anchored thereto as specified in Section 2417 (g). Ventilation shall be provided between the ground and a wood floor as specified in Section 2516.

(b) **Heavy Timber Floors.** Heavy timber floors shall be constructed as specified in Section 2514 (b).

(c) **Wood Sleepers.** Where wood sleepers are used for laying wood flooring on masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material in such a manner that there will be no open spaces under the flooring which will exceed one hundred square feet (100 sq. ft.) in area and such space shall be filled solidly under all partitions so that there is no communication under the flooring between adjoining rooms.

(d) **Mezzanine Floors.** Mezzanine floors may be of wood or unprotected steel except that in Fire Zone No. 1 they shall be of incombustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as specified for floors in Section 2514 (b).

Not more than two mezzanine floors shall be in any room of a building.

No mezzanine floor or floors shall cover more than 33 $\frac{1}{3}$  per cent of the area of any room.

**Sec. 2005.** Stairs may be constructed with any material allowed in this Code except that in Heavy Timber buildings stairs shall be constructed with wood treads and risers of not less than two-inch (2") nominal thickness, except where

**Stair  
Construction**

**Stair Construction (Cont'd.)** built on laminated or plank inclines as required for floors, when they may be of one-inch (1") nominal thickness or may be constructed as required in Type I buildings.

In buildings four or more stories in height, stairs and stair construction shall be as required for Type I buildings.

Stairs and exits shall be designed and constructed as specified in Chapter 33.

**Roofs** **Sec. 2006.** Roof decks shall be as required for floors in Section 2004.

## CHAPTER 21—TYPE IV BUILDINGS

**Sec. 2101.** The structural elements of Type IV Buildings shall be of incombustible materials. **Definition**

Type IV, One-Hour buildings shall be of incombustible construction and one-hour fire-resistive throughout.

Walls and permanent partitions shall be of incombustible materials.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

For requirements due to occupancy, see Chapters 6 to 13, inclusive.

For requirements in Fire Zones see Chapter 16.

**Sec. 2102.** Structural framework shall be as specified in Chapter 27 for iron and steel, Chapter 26 for concrete, and Chapter 24 for masonry. **Structural Framework**

**Sec. 2103. (a) Exterior Walls.** In Fire Zone No. 1, exterior walls within twenty feet (20') of a property line shall be of not less than two-hour fire-resistive construction. **Exterior Walls and Openings**

In Fire Zone No. 2, exterior walls within twenty feet (20') of a property line shall be of not less than one-hour fire-resistive construction.

**EXCEPTIONS:** 1. In Fire Zone No. 2, exterior walls of a building not greater in area than one thousand square feet (1000 sq. ft.) are not required to be of one-hour fire-resistive construction if three feet (3') or more from a property line.

2. Walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 and thirty feet (30') in Fire Zone No. 2 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A.

**(b) Openings in Walls.** In Fire Zone No. 1, openings in the exterior walls within twenty feet (20') of a property line shall be protected by Class "E" or "F" fire doors or windows. The sum of the widths of such openings shall not exceed 50 per cent of the total length of a wall in each story.

**EXCEPTION:** This shall not apply to openings which face directly upon and are fifty feet (50') or more from the opposite side of a public street or public place.

In Fire Zone No. 2, openings not on street fronts and which are within ten feet (10') of an adjacent property line shall be protected by Class "E" or "F" fire doors or windows.

Openings in inner court walls of buildings over one story in height shall be protected by Class "E" or "F" fire doors or windows when the least dimension of the court is less than forty feet (40').

**Floor Construction**      **Sec. 2104.** Floor construction shall be of incombustible material, provided, however, that a wood wearing surface or finish may be applied over such incombustible material.

**Stair Construction**      **Sec. 2105.** Stairs shall be of any type permitted by this Code and shall comply with the requirements of Chapter 33.

**Roof Construction**      **Sec. 2106.** Roofs shall be of incombustible construction. In Type IV, One-Hour buildings, roofs may be as specified in Section 1806.

Roof covering shall be a "fire-retardant" roofing as specified in Section 3204.

**CHAPTER 22—TYPE V BUILDINGS**

**Sec. 2201.** Type V Buildings may be of any materials **Definition** allowed by this Code.

Type V, One-Hour buildings shall be of one-hour fire-resistive construction throughout.

Materials of construction and fire-resistive requirements shall be as specified in Chapter 17.

For requirements due to occupancy, see Chapters 6 to 13, inclusive.

For requirements in Fire Zones, see Chapter 16.

**Sec. 2202.** Type V buildings three stories in height shall **Sheathing** have all exterior walls of the first story covered with solid sheathing as specified in this Section. Such sheathing, when of wood, shall be applied diagonally.

Sheathing shall be one or more of the following materials:

Wood not less than five-eighths inch ( $\frac{5}{8}$ " ) thick.

Fiberboard not less than seven-sixteenths inch ( $\frac{7}{16}$ " ) thick complying with U. B. C. Standard No. 22-1.

Gypsum sheathing not less than one-half inch ( $\frac{1}{2}$ " ) thick complying with U. B. C. Standard No. 22-2.

Plywood not less than five-sixteenths inch ( $\frac{5}{16}$ " ) thick complying with U. B. C. Standard No. 25-2.

**Sec. 2203.** (a) **Exterior Walls.** In Fire Zone No. 2, every exterior wall shall be of not less than one-hour fire-resistive construction. **Exterior Walls and Openings**

**EXCEPTION:** Exterior walls fronting on a street having a width of at least thirty feet (30') may be of unprotected incombustible construction, or may be protected on the exterior with materials as required for one-hour fire resistance. All structural members shall be fire protected as set forth in Table No. 17-A.

(b) **Openings in Walls.** In Fire Zone No. 2, openings not on street fronts and which are within ten feet (10') of an adjacent property line shall be protected by Class "E" or "F" fire doors or windows.

Openings in inner court walls of buildings over one story in height shall be protected by Class "E" or "F" fire doors or windows when the least dimension of the court is less than forty feet (40').

For enclosure of vertical openings, see Section 1706.

**Sec. 2204.** Stair construction may be of any type permitted in this Code and shall conform to the requirements of Chapter 33. **Stair Construction**

## PART VI

### ENGINEERING REGULATIONS— QUALITY AND DESIGN OF THE MATERIALS OF CONSTRUCTION

#### CHAPTER 23—LIVE AND DEAD LOADS

**Definitions**

Sec. 2301. The following definitions give the meaning of certain terms as used in this Chapter:

**DEAD LOAD.** The dead load of a building shall include the weight of the walls, permanent partitions, framing, floors, roofs, and all other permanent stationary construction entering into and becoming a part of a building.

**LIVE LOAD.** The live load includes all loads except dead and lateral loads.

**Loads**

Sec. 2302. (a) **General.** Buildings and all parts thereof shall be of sufficient strength to support the estimated or actual imposed dead and live loads in addition to their own proper dead load, without exceeding the stresses noted elsewhere in this Code, provided that no building or part thereof shall be designed for live loads less than those specified in this Chapter. Impact shall be considered in the design of any structure where impact loads occur.

(b) **Special.** Provisions shall be made in designing office floors for a load of 2000 pounds placed upon any space two and one-half feet ( $2\frac{1}{2}'$ ) square wherever this load upon an otherwise unloaded floor would produce stresses greater than those caused by a uniformly distributed load of 50 pounds per square foot.

In designing floors to be used for industrial or commercial purposes the actual live load caused by the use to which the building or part of the building is to be put, shall be used in the design of such building or part thereof, and special provision shall be made for machine or apparatus loads when such machine or apparatus would cause a greater load than specified for such use in Section 2304.

Floors in office buildings and in other buildings, where partition locations are subject to change, shall be designed to support, in addition to all other loads, a uniformly distributed load equal to 20 pounds per square foot.

Public garages and commercial or industrial buildings in which loaded trucks are placed, used, or stored shall have the floor systems designed to support a concentrated rear wheel load of a loaded truck placed in any possible position.

**Method  
of Design**

Sec. 2303. Any system or method of construction to be used shall admit of a rational analysis in accordance with well-established principles of mechanics.

All allowable stresses and soil-bearing values specified in this Code may be increased one-third due to wind or earthquake either acting alone or when combined with vertical loads. No increase shall be allowed for vertical loads acting alone.

Wind and earthquake loads need not be assumed to act simultaneously.

Sec. 2304. The unit loads set forth in Table No. 23-A shall be taken as the minimum live loads in pounds per square foot

Method  
of Design  
(Cont'd.)

Unit  
Live  
Loads

**TABLE NO. 23-A—UNIT LIVE LOADS**

|  |                    |
|--|--------------------|
| Apartments .....   | 40                 |
| Armories .....   | 150                |
| Auditoriums—Fixed Seats .....  | 50                 |
| Movable Seats .....  | 100                |
| Balconies and Galleries—Fixed Seats .....  | 50                 |
| Movable Seats .....  | 100                |
| Cornices .....   | 60                 |
| Corridors, Public .....  | 100                |
| Dance Halls .....  | 100                |
| Drill Rooms .....  | 100                |
| Dwellings .....  | 40                 |
| Exterior Balconies .....   | 100                |
| Fire Escapes .....   | 100                |
| Garages, storage or repair .....   | 100                |
| Garages, storage private pleasure cars .....   | 50                 |
| Gymnasiums .....   | 100                |
| Hospitals—Wards and Rooms .....  | 40                 |
| Hotels—Guest Rooms and Private Corridors .....   | 40                 |
| Libraries—Reading Rooms .....  | 60                 |
| Stack Rooms .....  | 125                |
| Loft Buildings .....   | 100                |
| Manufacturing—Light .....  | 75                 |
| Heavy .....  | 125                |
| Marquees .....   | 60                 |
| Offices .....  | 50                 |
| Printing Plants—Press Rooms .....  | 150                |
| Composing and Linotype Rooms .....   | 100                |
| Public Rooms .....   | 100                |
| Rest Rooms .....   | 50                 |
| Reviewing Stands and Bleachers .....   | 100                |
| Roof Loads .....   | (See Section 2305) |
| Schools—Classrooms .....   | 40                 |
| Sidewalks .....  | 250                |
| Skating Rinks .....  | 100                |
| Stairways .....  | 100                |
| Storage—Light .....  | 125                |
| Heavy (Load to be determined from proposed<br>use or occupancy, but never less than) ..... | 250                |
| Stores—Retail (Light Merchandise) .....  | 75                 |
| Wholesale (Light Merchandise) .....  | 100                |

**Unit  
Live  
Loads  
(Cont'd.)**

of horizontal projection to be used in the design of buildings for the occupancies listed, and loads at least equal shall be assumed for uses not listed in this Section but which create or accommodate similar loadings.

All ceiling joists shall be designed for not less than 10 pounds per square foot total load.

All balcony railings shall be designed to withstand a horizontal force of 20 pounds per lineal foot, applied at the top of the railing.

**Roof  
Loads**

**Sec. 2305.** Roofs shall sustain, within the stress limitations of this Code, all "dead loads" plus unit "live loads" as set forth in Table No. 23-B. The live loads shall be assumed to act vertically upon the area projected upon a horizontal plane.

Greenhouses, lath houses, and agricultural buildings shall be designed for a vertical live load of not less than 10 pounds.

Trusses and arches shall be designed to resist the stresses caused by unit live loads on one-half of the span if such loading results in reverse stresses, or stresses greater in any portion than the stresses produced by the required unit live load upon the entire span. For roofs whose structure is composed of a stressed shell, framed or solid, wherein stresses caused by any point loading are distributed throughout the area of the shell, the requirements for unbalanced unit live load design may be reduced 50 per cent.

**TABLE NO. 23-B—ROOF LIVE LOADS IN POUNDS  
PER SQUARE FOOT<sup>1</sup>**

| TRIBUTARY LOADED AREA<br>IN SQUARE FEET FOR ANY<br>STRUCTURAL MEMBER   | 0 to 200 | 201 to 600 | Over 600 |
|--|----------|------------|----------|
| <i>Roof member</i>   |          |            |          |
| Flat or rise less than 4<br>inches per foot.<br>Arch or dome with rise<br>less than $\frac{1}{8}$ of span.   | 20       | 16         | 12       |
| Rise 4 inches per foot to<br>less than 12 inches per<br>foot.<br>Arch or dome with rise $\frac{1}{8}$<br>of span to less than $\frac{3}{8}$ of<br>span or with radius $\frac{3}{4}$ or<br>greater of span. | 16       | 14         | 12       |
| Rise 12 inches per foot<br>and greater. Arch or<br>dome with rise $\frac{3}{8}$ of span<br>or greater, or radius less<br>than $\frac{3}{4}$ of span.   | 12       | 12         | 12       |

<sup>1</sup>Where snow loads occur, the roof structure shall be designed for such loads as determined by the Building Official.



When the form factor, as determined by wind tunnel tests or other recognized methods, indicates vertical or horizontal loads of lesser or greater severity than those produced by the loads herein specified, the roof structure may be designed accordingly.

**Roof  
Loads  
(Cont'd.)**

Snow load, full or unbalanced, or wind load shall be considered in place of loads as set forth in Table No. 23-B, where such loading will result in larger members or connections.

**Sec. 2306.** The following reductions in unit live loads as set forth in Table No. 23-A for floors shall be permitted in the designing of columns, piers, walls, foundations, trusses, beams, and flat slabs.

**Reduction  
of Live Loads**

Except for places of public assembly, and except for live loads greater than 100 pounds per square foot, the design live load on any member supporting one hundred fifty square feet (150 sq. ft.) or more may be reduced at the rate of 0.08 per cent per square foot of area supported by the member. The reduction shall not exceed 60 per cent nor "R" as determined by the following formula:

$$R=23.1 \left( 1 + \frac{D}{L} \right)$$

WHERE

R=Reduction in per cent

D=Dead load per square foot of area supported by the member

L=Unit live load per square foot of area supported by the member

For storage live loads exceeding 100 pounds per square foot, no reduction shall be made except that design live loads on columns may be reduced 20 per cent.

**Sec. 2307. (a) General.** Buildings and structures and every portion thereof shall be designed and constructed to resist the wind pressure as specified in this Section. All bracing systems both horizontal and vertical shall be designed and constructed to transfer the wind loads to the foundations.

**Wind  
Pressure**

**(b) Wind Pressure.** For purposes of design the wind pressure shall be taken upon the gross area of the vertical projection of buildings and structures at not less than 15 pounds per square foot for those portions of the building less than sixty feet (60') above ground and at not less than 20 pounds per square foot for those portions more than sixty feet (60') above ground.

The wind pressure upon roof tanks, roof signs, or other exposed roof structures and their supports shall be taken as not less than 30 pounds per square foot of the gross area of the plane surface, acting in any direction. In calculating the wind pressure on circular tanks, towers, or stacks this pressure shall be assumed to act on six-tenths of the projected area.

**Wind  
Pressure  
(Cont'd.)**

On open-framed structures the area used in computing wind pressure shall be one and one-half times the net area of the framing members in the side exposed to the wind.

Greenhouses, lath houses, and agricultural buildings shall be designed for a wind pressure of not less than 10 pounds per square foot.

(c) **Design.** The overturning moment calculated from the wind pressure shall in no case exceed two-thirds of the dead load resisting moment.

The weight of earth superimposed over footings may be used to calculate the dead load resisting moment.

(d) **Combined Wind and Live Loads.** For the purpose of determining stresses all vertical design loads except the roof live load and crane loads shall be considered as acting simultaneously with the wind pressure.

**Live Loads  
Posted**

**Sec. 2308.** The live loads for which each floor or part thereof of a commercial or industrial building is or has been designed shall have such designed live loads conspicuously posted by the owner in that part of each story in which they apply, using durable metal signs, and it shall be unlawful to remove or deface such notices. The occupant of the building shall be responsible for keeping the actual load below the allowable limits.

**Retaining  
Walls**

**Sec. 2309.** Retaining walls shall be designed to resist the lateral pressure of the retained material in accordance with accepted engineering practice. Walls retaining drained earth may be designed for pressure equivalent to that exerted by a fluid weighing not less than 30 pounds per cubic foot and having a depth equal to that of the retained earth. Any surcharge shall be in addition to the equivalent fluid pressure.

**Footing  
Design  
Walls and  
Structural  
Framing**

**Sec. 2310.** See Section 2805.

**Sec. 2311.** Walls and structural framing shall be erected true and plumb in accordance with the design. Bracing shall be placed during erection wherever necessary to take care of all loads to which the structure may be subjected.

**Earthquake  
Regulations**

**Sec. 2312.** For provisions covering Lateral Bracing (Earthquake Regulations) see Appendix Section 2312 and Seismic Probability Map of the United States on inside back cover.

## CHAPTER 24—MASONRY

**Sec. 2401.** All masonry shall conform to the regulations **Scope** of this Code.

**Sec. 2402.** For the purpose of this Chapter certain terms **Definitions** are defined as follows:

**DIMENSIONS.** Dimensions given are nominal; actual dimensions of unit masonry may not be decreased by more than one-half inch ( $\frac{1}{2}$ " ).

**GROSS CROSS-SECTIONAL AREA OF HOLLOW UNITS,** the total area including cells of a section perpendicular to the direction of loading. Re-entrant spaces are included in the gross area, unless these spaces are to be occupied in masonry by portions of adjacent units.

**MASONRY UNIT,** any brick, tile, stone, or block conforming to the requirements specified in Section 2403.

**Sec. 2403.** The quality and design of masonry materials **Materials** used structurally in buildings or structures shall conform to the requirements specified in this Chapter and to the following standards:

| MATERIALS AND DESIGN                                     | U.B.C.<br>DESIGNATION |
|--|-----------------------|
| <b>Building Brick</b>                                    |                       |
| Clay or Shale .....                                      | 24-1                  |
| Sand-Lime .....  | 24-2                  |
| Concrete .....   | 24-3                  |
| Sampling and Testing of .....                            | 24-4                  |
| <b>Concrete Masonry Units</b>                            |                       |
| Hollow Load-Bearing .....                                | 24-5                  |
| Solid Load-Bearing .....                                 | 24-6                  |
| Hollow Non-Load-Bearing .....                            | 24-7                  |
| <b>Structural Clay Tile</b>                              |                       |
| For Walls—Load-Bearing .....                             | 24-8                  |
| For Walls—Non-Bearing .....                              | 24-9                  |
| For Floors .....   | 24-10                 |
| <b>Gypsum</b>  |                       |
| General .....  | 24-11                 |
| Partition Tile or Block .....                            | 24-12                 |
| Reinforced .....   | 24-13                 |
| <b>Lime</b>  |                       |
| Quicklime .....  | 24-14                 |
| Hydraulic Hydrated Lime for Structural<br>Purposes ..... | 24-15                 |
| Hydrated Lime for Masonry Purposes .....                 | 24-16                 |
| Special Finishing Hydrated Lime .....                    | 24-17                 |
| <b>Cement</b>  |                       |
| Portland Cement .....                                    | 26-1                  |
| Masonry Cement .....                                     | 24-18                 |
| Air-Entraining Portland Cement .....                     | 24-19                 |
| <b>Aggregate for Masonry Mortar</b> .....                | 24-20                 |
| <b>Cast Stone</b> .....                                  | 24-21                 |

**Materials  
(Cont'd.)**

(a) **General.** Every masonry unit shall have all surfaces, to which mortar or grout is to be applied, capable of developing the masonry strengths required in this Chapter.

(b) **Brick Made from Clay or Shale.** Building brick of clay or shale shall be of a quality at least equal to the requirements set forth in U.B.C. Standard No. 24-1. When in contact with the ground, brick shall be of at least Grade MW. Where severe frost action occurs in the presence of moisture, brick shall be at least Grade SW.

(c) **Brick Made from Sand-Lime.** Building brick made from sand-lime shall be of a quality at least equal to the requirements set forth in U.B.C. Standard No. 24-2. When in contact with the ground, brick shall be of at least Grade MW. Where severe frost action occurs in the presence of moisture, brick shall be at least Grade SW.

(d) **Concrete Brick.** Building brick of concrete shall be of a quality at least equal to the requirements set forth in U.B.C. Standard No. 24-3.

(e) **Structural Clay Tile.** Structural clay tile shall be of a quality at least equal to the requirements set forth in U.B.C. Standard No. 24-8, Grade LB when used for bearing walls or piers, or Grade LBX when exposed to the weather or soil; or equal to the requirements set forth in U.B.C. Standard No. 24-9 when used for interior non-load-bearing purposes; or equal to the requirements set forth in U.B.C. Standard No. 24-10 when used for floor construction.

(f) **Concrete Masonry Units.** Concrete masonry units shall be of a quality at least equal to the requirements set forth in U.B.C. Standards Nos. 24-5 or 24-6 when used for bearing walls or piers, or when in contact with ground or exposed to the weather; or equal to the requirements set forth in U.B.C. Standard No. 24-7 when used for non-bearing purposes and not exposed to the weather. Solid units subject to the action of weather or soil shall be Grade A.

(g) **Gypsum Units.** Gypsum partition tile or block shall be of a quality at least equal to the requirements set forth in U.B.C. Standard No. 24-12.

(h) **Cast Building Stones.** Cast building stone shall be equal to the requirements set forth in U.B.C. Standard No. 24-21. Every concrete unit more than eighteen inches (18") in any dimension shall conform to the requirements for concrete in Chapter 26.

(i) **Unburned Clay Brick.** Unburned clay brick shall conform to the requirements specified in Section 2405.

(j) **Stone.** Natural stone shall be sound, clean, and in conformity with other provisions of this Chapter.

(k) **Structural Glass Block.** Structural glass block shall have unglazed surfaces to allow adhesion on all mortared faces.

(l) **Glazed Building Units.** Glazed brick shall conform to the structural requirements for building brick of clay or shale, and glazed structural tile shall conform to the structural requirements for structural clay tile.

(m) **Reinforcing Steel.** Reinforcing steel shall conform to the physical and chemical requirements for metal reinforcement in concrete, as specified in Chapter 26 of this Code.

(n) **Water.** Water used in mortar, grout, or masonry work shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other harmful substances.

(o) **Cement.** Cement for mortar shall be Types I, II, or III portland cement as set forth in U.B.C. Standard No. 26-1, or Types I-A, II-A, or III-A air-entraining portland cement as set forth in U.B.C. Standard No. 24-19, or Type II masonry cement as set forth in U.B.C. Standard No. 24-18.

**EXCEPTION:** Approved types of plasticizing agents may be added to portland cement Types I or II in the manufacturing process, but not in excess of 12 per cent of the total volume. Plastic or waterproofed cements so manufactured shall meet the requirements for portland cement as set forth in U.B.C. Standard No. 26-1 except in respect to the limitations on insoluble residue, air-entrainment, and additions subsequent to calcination.

(p) **Lime.** Quicklime shall conform to U.B.C. Standard No. 24-14. Hydrated lime shall conform to the requirements of U.B.C. Standard No. 24-16. Lime putty shall be made from quicklime or hydrated lime.

If made from quicklime, the lime shall be slaked and then screened through a 16-mesh sieve. After slaking, screening, and before using, it shall be stored and protected for not less than 10 days. The resulting lime putty shall weigh not less than 83 pounds per cubic foot.

**TABLE NO. 24-A—MORTAR PROPORTIONS\***  
(By Volume)

| TYPE | PORT-<br>LAND<br>CEMENT | HYDRATED LIME<br>OR LIME PUTTY |      | MA-<br>SONRY<br>CEMENT<br>TYPE II | DAMP<br>LOOSE<br>AGGREGATE                                  | MIN. COM-<br>PRESSIVE<br>STRENGTH<br>OF 2" CUBES<br>AT 28 DAYS<br>(psi) |
|------|-------------------------|--------------------------------|------|-----------------------------------|---|---|
|      |                         | Min.                           | Max. |                                   |   |   |
| A    | 1                       | ¼**                            | ½**  | —                                 | Not less<br>than 2½<br>and not<br>more than                 | 2,000   |
| B    | 1                       | ½                              | 1    | —                                 | 3 times<br>the sum<br>of the<br>volumes                     | 750   |
| C    | —                       | —                              | —    | 1                                 | of the<br>volumes<br>of the<br>cement<br>and limes<br>used. | 750   |
| D    | 1                       | 1¼                             | 2    | —                                 |   | 350   |

\*Mortar when applied shall have a flow after suction for one minute of not less than 70 per cent of that immediately before suction when determined by the method of water-retention test set forth in U.B.C. Standard No. 24-18.

\*\*When plastic or waterproof cement is used as specified in Section 2403(o), hydrated lime or lime putty may be added but not in excess of one-tenth the volume of cement.

**TABLE NO. 24-B—ALLOWABLE SHEAR ON BOLTS**  
Masonry of Unburned Clay Units

| DIAMETER OF BOLTS<br>(Inches) | EMBEDMENTS<br>(Inches) | SHEAR<br>(Pounds) |
|-------------------------------|------------------------|-------------------|
| $\frac{1}{2}$                 | ..                     | ...               |
| $\frac{3}{8}$                 | 12                     | 200               |
| $\frac{1}{2}$                 | 15                     | 300               |
| $\frac{3}{4}$                 | 18                     | 400               |
| 1                             | 21                     | 500               |
| $1\frac{1}{2}$                | 24                     | 600               |

**Materials**  
(Cont'd.)

(q) **Mortar.** 1. **General.** Mortar other than gypsum mortar used in masonry construction shall be classified as set forth in Table No. 24-A. Tests made to classify mortar by compressive strength shall be as set forth in U.B.C. Standard No. 24-18, using the proportions and materials proposed for use.

2. **Strength.** The strength of mortar using cementitious materials set forth in Table No. 24-A shall meet the minimum compressive strength shown. Tests to verify compliance with the requirements of this Section may be required by the Building Official. (See Section 2404.)

(r) **Grout.** Grout shall be composed by volume, of one part portland cement and three parts sand, to which may be added not more than one-tenth part lime. Sufficient water shall be added to produce consistency for pouring without segregation of the constituents of the grout.

In grout spaces in brick masonry two inches (2") or more in horizontal dimension and in grout spaces in filled-cell construction four inches (4") or more in both horizontal dimensions, the grout may contain an addition of pea gravel equal to not more than two parts by volume of cement used. Such pea gravel shall be graded with not more than 5 per cent passing the No. 8 sieve and 100 per cent passing the three-eighths-inch ( $\frac{3}{8}$ ") sieve.

Grout shall attain a compressive strength of 2000 pounds per square inch at 28 days. Tests to verify compressive strength may be required by the Building Official.

(s) **Mortar Limitations.** Masonry units used in foundation walls and footings shall be laid up in Type A mortar. Type D mortar shall be used only in interior non-structural walls.

(t) **Aggregates.** Aggregates for mortar shall be of a quality at least equal to that set forth in U.B.C. Standard No. 24-20.

(u) **Rate of Absorption.** At the time of laying, burned clay units and sand-lime units shall have a rate of absorption not exceeding 0.025 ounces per square inch during a period

of one minute. In the absorption test the surface of the unit shall be held one-eighth inch ( $\frac{1}{8}$ " ) below the surface of the water.

(v) **Re-Use of Masonry Units.** Masonry units may be re-used when cleaned, whole, and conforming to the other requirements of this Chapter appropriate to the type of unit.

(w) **Gypsum.** Gypsum shall conform to U.B.C. Standard No. 24-11.

**Sec. 2404. (a) General.** Tests of materials shall be made in accordance with the standard method prescribed for the material in question. **Tests**

(b) **Load Tests.** When a load test is required, the member or portion of the structure under consideration shall be subject to a superimposed load equal to twice the design live load plus one-half of the dead load. This load shall be left in position for a period of 24 hours before removal. If, during the test or upon removal of the load, the member or portion of the structure shows evidence of failure, such changes or modifications as are necessary to make the structure adequate for the rated capacity shall be made; or where lawful, a lower rating shall be established. A flexural member shall be considered to have passed the test if the maximum deflection  $D$  at the end of the 24-hour period neither exceeds

$$D = \frac{L}{200} \text{ nor } D = \frac{L^2}{4000t} \text{ and the beams and slabs show a}$$

recovery of at least 75 per cent of the observed deflection within 24 hours after removal of the load.

**WHERE:**

$L$  = span of the member in feet

$t$  = thickness or depth of the member in feet.

(c) **Preliminary tests.** When the strength of masonry is to be established by preliminary tests, the tests shall be made in advance of the beginning of operations, using prisms built of the same materials under the same conditions and insofar as possible with the same bonding arrangement as for the structure. In building the prisms, the moisture content of the units at time of laying, the consistency of the mortar, and the workmanship shall be the same as will be used in the structure.

The compressive strength shall be computed by dividing the ultimate load by the net area of the masonry used in construction of the prism.

1. **Solid masonry.** In solid masonry, test prisms for beams and slabs shall be approximately eight inches by eight inches by twenty-five inches ( $8" \times 8" \times 25"$ ), built in a horizontal position with unselected units laid as stretchers in running bond, two bricks wide and three courses high, with one-half-inch ( $\frac{1}{2}$ " ) joints. Prisms representing walls shall be approximately eight inches by sixteen inches ( $8" \times 16"$ ) in

### Tests (Cont'd.)

plan and sixteen inches (16") high. Those representing columns or pedestals shall be approximately eight inches by eight inches (8" x 8") in plan and sixteen inches (16") high.

2. **Hollow-unit masonry.** In hollow-unit masonry, test prisms shall be built in the form of hollow squares eight inches by eight inches (8" x 8") in plan and sixteen inches (16") high or in the form of rectangles eight inches by sixteen inches (8" x 16") in plan and sixteen inches (16") high. The hollow core shall not be filled with grout.

3. **Storage of test prisms.** Test prisms shall be stored for seven days in air at a temperature of  $70^{\circ} \pm 5^{\circ}$  Fahrenheit and a relative humidity exceeding 90 per cent and then in air at a temperature of  $70^{\circ} \pm 5^{\circ}$  Fahrenheit and a relative humidity of 30 per cent to 50 per cent until tested. Prisms shall be capped and tested in compression similar to tests for molded concrete cylinders. Not less than five specimens shall be made for each test. The standard age of test specimens shall be 28 days, but seven-day tests may be used, provided the relation between the seven-day and 28-day strengths of the masonry is established by test for the materials used.

### Unburned Clay Masonry

Sec. 2405. (a) **General.** Masonry of unburned clay units shall not be used in any building more than one story in height. The unsupported height of every wall of unburned clay units shall be not more than 10 times the thickness of such walls. Bearing walls shall in no case be less than sixteen inches (16"). Fireplaces and chimneys of unburned clay units shall be lined with firebrick not less in thickness than four inches (4"). All footing walls which support masonry of unburned clay units shall extend to an elevation not less than six inches (6") above the adjacent ground at all points.

(b) **Units.** At the time of laying, all units shall be clean and damp at the surface.

(c) **Laying.** All joints shall be solidly filled with mortar. Bond shall be provided as specified for masonry of hollow units in Section 2411.

(d) **Stresses.** All masonry of unburned clay units shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-G. Bolt values shall not exceed those set forth in Table No. 24-B.

(e) **Soil.** The soil used shall contain not less than 25 per cent and not more than 45 per cent of material passing a No. 200-mesh sieve. The soil shall contain sufficient clay to bind the particles together but shall not contain more than 0.2 per cent of water-soluble salts.

(f) **Stabilizer.** The stabilizing agent shall be emulsified asphalt. The stabilizing agent shall be uniformly mixed with the soil in amounts sufficient to provide the required resistance to absorption.

(g) **Sampling.** Each of the tests prescribed in this Section shall be applied to five sample units selected at random from each 5000 bricks to be used.



(h) **Compressive Strength.** The units shall have an average compressive strength of 300 pounds per square inch when tested in accordance with U.B.C. Standard No. 24-4. One sample out of five may have a compressive strength of not less than 250 pounds per square inch.

**Unburned  
Clay  
Masonry  
(Cont'd.)**

(i) **Modulus of Rupture.** The unit shall average 50 pounds per square inch in modulus of rupture when tested according to the following procedure:

1. A cured unit shall be laid over cylindrical supports two inches (2") in diameter, located two inches (2") from each end, and extending across the full width of the unit.

2. A cylinder two inches (2") in diameter shall be laid midway between and parallel to the supports.

3. Load shall be applied to the cylinder at the rate of 500 pounds per minute until rupture occurs.

4. The modulus of rupture is equal to 
$$\frac{3 WL}{2 Bd^2}$$

WHERE:

W = Load of rupture

L = Distance between supports

B = Width of brick

d = Thickness of brick

(j) **Moisture Content.** The moisture content of the unit shall be not more than 4 per cent by weight.

(k) **Absorption.** A dried four-inch (4") cube cut from a sample unit shall absorb not more than 2½ per cent moisture by weight when placed upon a constantly water-saturated porous surface for seven days.

(l) **Shrinkage Cracks.** No units shall contain more than three shrinkage cracks, and no shrinkage crack shall exceed three inches (3") in length or one-eighth inch (⅛") in width.

(m) **Mortar.** All mortar used in masonry of unburned clay units shall be Type A mortar.

**Sec. 2406. (a) General.** Gypsum masonry is that form of construction made with gypsum block or tile in which the units are laid and set in gypsum mortar. Gypsum masonry shall not be used in any bearing wall or where exposed directly to the weather or where subject to frequent or continuous wetting.

**Gypsum  
Masonry**

(b) **Materials.** Gypsum masonry shall be gypsum block or tile laid up in gypsum mortar composed of one part gypsum and not more than three parts sand by weight.

(c) **Stresses.** All gypsum masonry shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-G when computed on the gross cross-sectional area.

(d) **Bond.** The bond in gypsum masonry shall conform to the requirements for bond in masonry or hollow units specified in Section 2411.

(e) **Method of Laying.** All units in gypsum masonry shall be placed in side construction with cells horizontal. The entire bearing surface of every unit shall be covered with mortar spread in an even layer, and all joints shall be filled with mortar.

## Reinforced Gypsum

**Sec. 2407. (a) General.** Reinforced gypsum shall consist of a mixture of gypsum with wood chips, shavings, or fiber or other approved aggregates, premixed at the mill with only water added at the job. Precast reinforced gypsum shall contain not more than 3 per cent, and cast-in-place reinforced gypsum not more than 12½ per cent of wood chips, shavings, or fiber measured as a percentage by weight of dry mix.

Reinforced gypsum shall develop the minimum ultimate compressive strength in pounds per square inch set forth in Table No. 24-C when dried to constant weight, with tests made on cylinders six inches (6") in diameter and twelve inches (12") long.

Tests when required shall follow the procedure set forth in U.B.C. Standard No. 24-13.

For continuous inspection, see Section 305(a).

(b) **Design.** For precast slabs which cannot be analyzed in accordance with established principles of mechanics, the safe load, uniformly distributed, shall be taken as one-fifth of the total load causing failure in a full-size test panel with the load applied along two lines each distant one-fourth of the clear span from the support.

The minimum thickness of reinforced gypsum shall be two inches (2") except in the suspension system, which shall be not less than three inches (3"). Hollow precast reinforced gypsum units for roof construction shall be not less than three inches (3") thick and the shell not less than one-half inch (½") thick.

Precast gypsum units shall be reinforced and, unless the shape or marking of the unit is such as to insure its being placed right side up, the reinforcement shall be placed symmetrically so that the unit can support its load either side up.

In slabs of the suspension type, the reinforcement shall consist of wires with continuity through multiple spans and anchored at the ends. The wires shall be supported in the top of the slab by the roof or floor beams and shall be tightly drawn down as near to the bottom of the slab at mid-span as fire protection requirements will allow, but not closer than one-half inch (½"). Provisions shall be made in the framing of the end bays of this system for resisting the forces due to end anchorage of the wires. The wires shall be designed for

a tension in pounds per foot width of slab equal to:  $\frac{wL^2}{8d}$

WHERE:

w = The total load in pounds per square foot

L = The clear span in feet

d = The sag of the wires in feet

(c) **Stresses.** The maximum allowable unit working stresses in reinforced gypsum shall not exceed the values set forth in Table No. 24-D except as specified in Chapter 23. Bolt values shall not exceed those set forth in Table No. 24-E.

**TABLE NO. 24-C—MINIMUM ULTIMATE  
COMPRESSIVE STRENGTH  
Reinforced Gypsum**

| CLASS | MIXTURE   | COMPRESSIVE<br>STRENGTH<br>(Pounds per<br>Square Inch) |
|-------|---|--|
| A     | Not more than 12½ per cent by weight of wood chips, shavings, or fiber. | 500  |
| B     | Not more than 3 per cent by weight of wood chips, shavings, or fiber.   | 1000   |

**TABLE NO. 24-D—ALLOWABLE UNIT WORKING  
STRESS  
Reinforced Gypsum**

| TYPE OF STRESS        | CLASS A<br>(Pounds per Square Inch) | CLASS B<br>(Pounds per Square Inch) |
|-----------------------|-------------------------------------|-------------------------------------|
| Compression—Flexural  | 125                                 | 220                                 |
| Compression—Bearing   | 100                                 | 165                                 |
| Bond and Shear        | 10                                  | 20                                  |
| Modulus of Elasticity | 200,000                             | 600,000                             |

Note: Reinforced anchored or electrically welded wire mesh reinforcement shall be considered as meeting the bond and shear requirements of this Section.

**TABLE NO. 24-E—SHEAR ON ANCHOR BOLTS  
AND DOWELS  
Reinforced Gypsum**

| BOLT OR DOWEL SIZE<br>(Inches) | EMBEDMENT<br>(Inches) | SHEAR<br>(Pounds) |
|--------------------------------|-----------------------|-------------------|
| ⅜ Bolt                         | 4                     | 250               |
| ½ Bolt                         | 4                     | 350               |
| ⅝ Bolt                         | 4                     | 500               |
| ¾ Plain dowel                  | 6                     | 200               |
| ⅜ Deformed dowel               | 6                     | 250               |
| ½ Deformed dowel               | 6                     | 350               |

**Glass  
Masonry**

**Sec. 2408. (a) General.** Masonry of glass blocks may be used in non-load-bearing exterior or interior walls and in openings which might otherwise be filled with windows, either isolated or in continuous bands, provided the glass block panels have a minimum thickness of three and one-half inches (3½") at the mortar joint and the mortared surfaces of the blocks are treated for mortar bonding.

(b) **Horizontal Forces.** The panels shall be restrained laterally to resist the horizontal forces specified in Chapter 23 for bearing walls.

(c) **Size of Panels.** Glass block panels for exterior walls shall not exceed one hundred forty-four square feet (144 sq. ft.) of unsupported wall surface nor fifteen feet (15') in any dimension. For interior walls, glass block panels shall not exceed two hundred fifty square feet (250 sq. ft.) of unsupported area nor twenty-five feet (25') in any dimension.

(d) **Mortar.** Glass block shall be laid in Type A mortar. Both vertical and horizontal mortar joints shall be at least one-fourth inch (¼") and not more than three-eighths inch (⅜") thick and shall be completely filled.

(e) **Expansion Joints.** Every exterior glass block panel shall be provided with one-half-inch (½") expansion joints at the sides and top. Expansion joints shall be entirely free of mortar, and shall be filled with resilient material.

**Stone  
Masonry**

**Sec. 2409. (a) General.** Stone masonry is that form of construction made with natural or cast stone in which the units are laid and set in mortar, with all joints thoroughly filled.

(b) **Construction.** In ashlar masonry, bond stones uniformly distributed shall be provided to the extent of not less than 10 per cent of the area of exposed facets.

Rubble stone masonry twenty-four inches (24") or less in thickness shall have bond stones with a maximum spacing of three feet (3') vertically and three feet (3') horizontally, and if the masonry is of greater thickness than twenty-four inches (24"), shall have one bond stone for each six square feet (6 sq. ft.) of wall surface on both sides.

(c) **Minimum Thickness.** Stone masonry walls shall in no case have a minimum thickness of less than sixteen inches (16").

(d) **Stresses.** The allowable unit working stresses in stone masonry shall not exceed the values set forth in Table No. 24-G. Bolt values shall not exceed those set forth in Table No. 24-F.

**Cavity Wall  
Masonry**

**Sec. 2410. (a) General.** Cavity wall masonry is that type of construction made with brick, structural clay tile, or concrete masonry units or any combination of such units in which facing and backing are completely separated except for the metal ties which serve as bonding.

(b) **Construction.** In cavity walls neither the facing nor the backing shall be less than three and one-half inches (3½") in net thickness and the cavity shall be not less than one inch (1") net in width nor more than three inches (3") in

width. The facing and backing of cavity walls shall be bonded with three-sixteenths-inch (3/16") diameter steel rods or metal ties of equivalent stiffness embedded in the horizontal joints. There shall be one metal tie for not more than each four and one-half square feet (4½ sq. ft.) of wall area. Ties in alternate courses shall be staggered and the maximum vertical distance between ties shall not exceed eighteen inches (18"), and the maximum horizontal distance shall not exceed thirty-six inches (36"). Rods bent to rectangular shape shall be used with hollow masonry units laid with the cells vertical; in other walls the ends of ties shall be bent to 90 degree angles to provide hooks not less than two inches (2") long. Additional bonding ties shall be provided at all openings, spaced not more than three feet (3') apart around the perimeter and within twelve inches (12") of the opening. Ties shall be of corrosion-resistant metal, or shall be coated with a corrosion-resistant metal or other approved protective coating.

(c) **Maximum Height.** The maximum height of cavity walls shall be as specified in Section 2418 (e).

(d) **Stresses.** The allowable unit working stresses in cavity wall construction shall not exceed the values set forth in Table No. 24-G. Bolt values shall not exceed those set forth in Table No. 24-F.

**Sec. 2411. (a) General.** Hollow unit masonry is that type of construction made with hollow masonry units in which the units are all laid and set in mortar.

All units shall be laid with full face shell mortar beds. All head and end joints shall be filled solidly with mortar for a distance in from the face of the unit or wall not less than the thickness of the longitudinal face shells.

(b) **Construction.** Where two or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals not exceeding thirty-four inches (34") by lapping at least four inches (4") over the unit below or by lapping at vertical intervals not exceeding seventeen inches (17") with units which are at least 50 per cent greater in thickness than the units below; or by bonding with corrosion-resistant metal ties conforming to the requirements for cavity walls. There shall be one metal tie for not more than each four and one-half square feet (4½ sq. ft.) of wall area. Ties in alternate courses shall be staggered, and the maximum vertical distance between ties shall not exceed eighteen inches (18"), and the maximum horizontal distance shall not exceed thirty-six inches (36"). Walls bonded with metal ties shall conform to the requirements for allowable stress, lateral support, thickness (excluding cavity), height, and mortar for cavity walls.

(c) **Stresses.** All hollow unit masonry shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-G. Bolt values shall not exceed those set forth in Table No. 24-F.

**Sec. 2412. (a) General.** Plain solid masonry shall be brick, concrete brick, or solid load-bearing concrete masonry units, laid contiguously in mortar.

**Plain Hollow Unit Masonry**

**Plain Solid Masonry**

**TABLE NO. 24-F—ALLOWABLE SHEAR ON BOLTS**  
**For All Masonry Except Gypsum and Unburned Clay Units**

| DIAMETER OF BOLT (Inches) | EMBEDMENT (Inches) | PLAIN MASONRY (Shear in Pounds) | GROUTED MASONRY (Shear in Pounds) |
|---------------------------|--------------------|---------------------------------|-----------------------------------|
| $\frac{3}{4}$             | 4                  | 350                             | 550                               |
| $\frac{5}{8}$             | 4                  | 500                             | 750                               |
| $\frac{3}{4}$             | 5                  | 750                             | 1100                              |
| $\frac{7}{8}$             | 6                  | 1000                            | 1500                              |
| 1                         | 7                  | 1250                            | 1850*                             |
| $1\frac{1}{8}$            | 8                  | 1500                            | 2250*                             |

\*Permitted only with not less than 2500 p.s.i. units.

**Plain Solid Masonry (Cont'd.)**

All units shall be laid with full shoved mortar joints, and all head, bed, and wall joints shall be solidly filled with mortar.

(b) **Construction.** Bonding shall be by either of the following methods:

1. **Headers.** The facing and backing shall be bonded so that not less than 4 per cent of the wall surface of each face is composed of bonders (headers) extending not less than four inches (4") into the backing. The distance between adjacent full-length headers shall not exceed twenty-four inches (24") either vertically or horizontally. In walls in which a single bondor does not extend through the wall, bonders from the opposite sides shall overlap at least four inches (4"), or bonders from opposite sides shall be covered with another bondor course overlapping the bondor below at least four inches (4").

2. **Metal Ties.** The facing and backing shall be bonded with corrosion-resistant metal ties conforming to the requirements for cavity walls. There shall be one metal tie for not more than each four and one-half square feet ( $4\frac{1}{2}$  sq. ft.) of wall area. Ties in alternate courses shall be staggered, and the maximum vertical distance between ties shall not exceed eighteen inches (18"), and the maximum horizontal distance shall not exceed thirty-six inches (36"). Walls so bonded shall conform to the allowable stress, lateral support, thickness (excluding cavity), height, and mortar requirements for cavity walls.

(c) **Moisture Content.** For moisture content, see Section 2403 (u).

(d) **Stresses.** All plain solid masonry shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-G. Bolt values shall not exceed those set forth in Table No. 24-F.

**Plain Grouted Masonry**

Sec. 2413. (a) **General.** Plain grouted masonry is that form of construction made with brick or solid concrete brick units in which interior joints of masonry are filled by pouring grout therein as the work progresses.

(b) **Materials.** At the time of laying, all masonry units shall be free of excessive dust and dirt. For moisture content, see Section 2403 (u). Only Type A mortar shall be used.

Plain  
Grouted  
Masonry  
(Cont'd.)

(c) **Construction.** Requirements for construction shall be as follows:

1. All units in the two outer tiers shall be laid with full shoved head and bed mortar joints.
2. All longitudinal vertical joints shall be grouted and shall be not less than three-fourths inch ( $\frac{3}{4}$ " ) in thickness. In members of three or more tiers in thickness, interior bricks shall be embedded into the grout so that at least three-fourths inch ( $\frac{3}{4}$ " ) of grout surrounds the sides and ends of each unit.
3. One exterior tier may be carried up twelve inches (12") before grouting, but the other exterior tier shall be grouted in lifts not to exceed four inches (4") or one unit, whichever is greater.

**TABLE NO. 24-G—ALLOWABLE WORKING STRESSES  
IN UNREINFORCED UNIT MASONRY\*\***

| MATERIAL<br>Grade of Unit   | TYPE A MORTAR       |                                      |                      | TYPE B & C MORTAR  |                                      |                   |
|---|---------------------|--------------------------------------|----------------------|--------------------|--------------------------------------|-------------------|
|   | Com-<br>pression    | Tension<br>in<br>Flexure<br>or Shear |                      | Com-<br>pression   | Tension<br>in<br>Flexure<br>or Shear |                   |
| Continuous Inspection<br>Required   | No                  | Yes                                  | No                   | No                 | Yes                                  | No                |
| PLAIN SOLID BRICK MASONRY<br>4500 plus<br>2500 to 4500 psi<br>1500 to 2500 psi                                      | 250<br>175<br>125   | 20<br>20<br>20                       | 10<br>10<br>10       | 200<br>140<br>100  | 15<br>15<br>15                       | 7.5<br>7.5<br>7.5 |
| PLAIN SOLID CONCRETE<br>BRICK UNITS<br>Grade A<br>Grade B   | 175<br>125          | 12<br>12                             | 6<br>6               | 125<br>100         | 12<br>12                             | 6<br>6            |
| PLAIN GROUTED MASONRY<br>4500 plus<br>2500 to 4500 psi<br>1500 to 2500 psi  | 350<br>275<br>225   | 25<br>25<br>25                       | 12.5<br>12.5<br>12.5 |                    |                                      |                   |
| HOLLOW UNIT MASONRY   | 85                  | 12*                                  | 6*                   | 70                 | 10*                                  | 5*                |
| CAVITY WALL MASONRY<br>Solid units<br>Grade A or 2500<br>psi plus<br>Grade B or 1500 to<br>2500 psi<br>Hollow units | 140*<br>100*<br>70* | 12*<br>12*<br>12*                    | 6*<br>6*<br>6*       | 110*<br>80*<br>50* | 10*<br>10*<br>10*                    | 5*<br>5*<br>5*    |
| STONE MASONRY<br>Cast Stone<br>Natural Stone  | 400<br>140          | 8<br>4                               | 4<br>—               | 320<br>100         | 8<br>4                               | 4<br>4            |
| GYPSUM MASONRY  | 20                  | —                                    | —                    | 20                 | —                                    | —                 |
| UNBURNED CLAY MASONRY   | 30                  | 8                                    | 4                    |                    |                                      |                   |

\*Net area.

\*\*Allowable working stresses psi gross cross-sectional area (except as noted).

TABLE NO. 24-H—MAXIMUM WORKING STRESSES

## Reinforced Solid and Hollow Unit Masonry

| TYPE OF STRESS   | FACTOR       | SOLID MASONRY UNITS           |                  |                                    | HOLLOW MASONRY UNITS          |                  |                                    |
|--|--------------|-------------------------------|------------------|------------------------------------|-------------------------------|------------------|------------------------------------|
|  |              | Continuous Inspection         |                  | Without Contin-<br>uous Inspection | Continuous Inspection         |                  | Without Contin-<br>uous Inspection |
|  |              | Special*<br>Condition         | 2500 psi<br>Min. | 1500 psi<br>Min.                   | Special*<br>Condition         | Grade<br>A Units | Grade<br>A Units                   |
|  |              | $f'_m$ by Test<br>Max. = 2000 | $f'_m = 1500$    | $f'_m = 750$                       | $f'_m$ by Test<br>Max. = 1600 | $f'_m = 1200$    | $f'_m = 600$                       |
| Compression—Axial  | 0.20 $f'_m$  | 400                           | 300              | 150                                | 320                           | 240              | 120                                |
| Compression—Flexural                                     | 0.33 $f'_m$  | 670                           | 500              | 250                                | 533                           | 400              | 200                                |
| Shear** (No shear<br>reinforcement)                      | 0.02 $f'_m$  | 40                            | 30               | 15                                 | 32                            | 24               | 12                                 |
| Shear** (Shear reinforcement<br>taking 2/3 entire shear) | 0.04 $f'_m$  | 80                            | 60               | 30                                 | 64                            | 48               | 24                                 |
| Bearing**  | 0.25 $f'_m$  | 500                           | 375              | 187                                | 400                           | 300              | 150                                |
| Modulus of Elasticity                                    | 1,000 $f'_m$ | 2,000,000                     | 1,500,000        | 750,000                            | 1,600,000                     | 1,200,000        | 600,000                            |
| Modulus of Rigidity                                      | 400 $f'_m$   | 800,000                       | 600,000          | 300,000                            | 640,000                       | 480,000          | 240,000                            |
| Bond—Plain bars  |              | 60                            | 60               | 30                                 | 60                            | 60               | 30                                 |
| Bond—Deformed bars                                       |              | 130                           | 130              | 90                                 | 130                           | 130              | 90                                 |

\*See Section 2417 (k)2.

\*\*Using net sections, including cells that are filled with grout or concrete.



4. If the work is stopped for one hour or longer, the horizontal construction joints shall be formed by stopping all tiers at the same elevation and with the grout one inch (1") below the top.

(d) **Stresses.** All plain grouted masonry shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-G. Bolt values shall not exceed those set forth in Table 24-F.

**Sec. 2414. (a) General.** Reinforced grouted masonry shall conform to all of the requirements for plain grouted masonry specified in Section 2413 and also the requirements of this Section.

(b) **Construction.** The thickness of grout or mortar between brick and steel shall be not less than one-fourth inch ( $\frac{1}{4}$ "), except that one-fourth inch ( $\frac{1}{4}$ ") bars may be laid in one-half-inch ( $\frac{1}{2}$ ") horizontal mortar joints.

(c) **Stresses.** All reinforced grouted masonry shall be so designed and constructed that the unit stresses do not exceed those set forth in Table No. 24-H. Bolt values shall not exceed those set forth in Table No. 24-F.

**Sec. 2415. (a) General.** Reinforced hollow unit masonry is that type of construction made with hollow masonry units in which certain cells are continuously filled with concrete or grout, and in which reinforcement is embedded.

(b) **Construction.** Requirements for construction shall be as follows:

1. All reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full-bedded in mortar to prevent leakage of grout. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells. Bond shall be provided by lapping units in successive vertical courses or by equivalent mechanical anchorage.

2. Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than two inches by three inches (2" x 3").

3. Cleanout openings shall be provided at the bottoms of all cells to be filled at each lift or pour of grout where such lift or pour of grout is in excess of four feet (4') in height. Any overhanging mortar or other obstruction or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting, after inspection.

4. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

5. All cells containing reinforcement shall be filled solidly with grout. Vertical cells containing reinforcement shall be filled solidly with grout in lifts not exceeding eight feet (8') in height.

**Reinforced  
Grouted  
Masonry**

**Reinforced  
Hollow Unit  
Masonry**

6. When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout one and one-half inches (1½") below the top of the uppermost unit.

(c) **Stresses.** All reinforced hollow unit masonry shall be so designed and constructed that the unit stresses do not exceed those set forth in Table No. 24-H. Bolt values shall not exceed those set forth in Table No. 24-F.

#### General Construction Requirements

**Sec. 2416. (a) Freezing.** All masonry shall be protected against freezing for at least 48 hours after being laid. No masonry shall be built upon frozen material.

(b) **Corbeling.** Corbels may be built only into solid masonry walls twelve inches (12") or more in thickness. The projection for each course in such corbel shall not exceed one inch (1"), and the maximum projection shall not exceed one-third (1/3) the total thickness of the wall when used to support structural members, and not more than six inches (6") when used to support a chimney built into the wall. The top course of all corbels shall be a header course.

(c) **Wood.** No structural masonry shall be supported by wood members.

**EXCEPTIONS:** 1. Wood piling as specified in Section 2807.

2. Wood floor and roof members used in horizontal trusses and horizontal diaphragms.

3. Basement walls supporting one-story dwellings laterally supported by wood floor members.

4. Wood walls or trusses may be used as vertical resisting elements for one-story masonry buildings.

**Sec. 2417. (a) Combination of Units.** In walls or other structural members composed of different kinds or grades of units, materials, or mortars, the maximum stress shall not

#### General Design

**TABLE NO. 24-I—MINIMUM THICKNESS OF MASONRY WALLS**

| TYPE OF MASONRY                  | MAX. RATIO<br>UNSUPPORTED<br>HEIGHT OR<br>LENGTH TO<br>THICKNESS | NOMINAL<br>MINIMUM<br>THICK-<br>NESS<br>(Inches) |
|----------------------------------|--|--|
| <b>Bearing Walls:</b>            |  |  |
| Unburned Clay Masonry            | 10   | 16   |
| Stone Masonry                    | 14   | 16   |
| Cavity Wall Masonry              | 18   | 8  |
| Plain Hollow Unit Masonry        | 18   | 8  |
| Plain Solid Masonry              | 20   | 8  |
| Plain Grouted Masonry            | 20   | 7  |
| Reinforced Grouted Masonry       | 25   | 6  |
| Reinforced Hollow Unit Masonry   | 25   | 6  |
| <b>Non-Bearing Walls:</b>        |  |  |
| Exterior Unreinforced Walls      | 20   | 2  |
| Exterior Reinforced Walls        | 30   | 2  |
| Interior Partitions Unreinforced | 36   | 2  |
| Interior Partitions Reinforced   | 48   | 2  |

General  
Design  
(Cont'd.)

exceed the allowable stress for the weakest of the combinations of units, materials, and mortars of which the member is composed. The thickness of any facing which is used to resist stress shall be not less than one and one-half inches ( $1\frac{1}{2}$ " ).

(b) **Thickness of Walls.** For arbitrary limits of walls as specified in this Chapter, nominal thickness shall be used. Stresses shall be determined on the basis of the net thickness of the masonry, with consideration for reductions such as raked joints.

The thickness of masonry walls shall be designed so that allowable maximum stresses specified in this Chapter are not exceeded and so that all masonry walls shall not exceed the height or length to thickness ratio nor the minimum thickness as specified in this Chapter and as set forth in Table No. 24-I.

(c) **Piers.** Every structural pier whose width is less than three times its thickness shall be designed and constructed as required for columns.

(d) **Chases and Recesses.** Chases and recesses in masonry walls shall be designed and constructed so as not to reduce the required strength or required fire resistance of the wall.

(e) **Pipes and Conduits Embedded in Masonry.** No pipe or conduit shall be embedded in any structural masonry or required fire protection.

**EXCEPTIONS:** 1. Rigid electric conduits may be embedded in structural masonry when their location has been detailed on the approved plans.

2. Any pipe or conduit may pass vertically or horizontally through any masonry by means of a sleeve at least large enough to pass any hub or coupling on the pipe line. Such sleeves shall be placed not closer than three diameters, center to center, nor shall they unduly impair the strength of construction.

3. Placement of pipes or conduits in unfilled cores of hollow unit masonry shall not be considered as embedment.

(f) **Arches and Lintels.** Members supporting masonry shall be of incombustible materials.

(g) **Anchorage.** Masonry walls that meet or intersect shall be bonded or anchored.

Wood joists or wood beams shall be anchored to masonry walls at intervals not exceeding four feet (4') by metal anchors having a minimum cross section of twenty-five hundredths square inch (0.25 sq. in.), fastened to the joists or beams at one end of the anchor by means of a one-half-inch ( $\frac{1}{2}$ " ) diameter bolt or other approved method, and at the other end of the anchor in the form of a T embedded in the masonry not less than three and one-half inches ( $3\frac{1}{2}$ " ) with the T vertical, or other approved method.

Where joists run parallel to walls, said anchors shall be carried beyond the third joist and shall be solid bridged to the walls.

Structural members framing into or supported by walls or columns shall be anchored.

General  
Design  
(Cont'd.)

(h) Combined Axial and Flexural Stresses. Members subject to combined axial and flexural stresses shall be so proportioned that the quantity  $\frac{f_a}{F_a} + \frac{f_b}{F_b}$  shall not exceed 1

WHERE:

$f_a$  = Computed axial unit stress, determined from total axial load and gross area.

$F_a$  = Axial unit stress permitted by this Code at the point under consideration, if member were carrying axial load only, including any increase in stress allowed by this Section.

$f_b$  = Computed flexural unit stress.

$F_b$  = Flexural unit stress permitted by this Code, if member were carrying bonding load only, including any increase in stress allowed by this Section.

(i) **Allowable Reduction of Bending Stress by Vertical Load.** In calculating maximum tensile fiber stress due to lateral forces other than earthquake forces, the maximum tensile fiber stress may be reduced by the direct stress due to vertical dead loads. In calculating maximum tensile fiber stress due to earthquake forces, the maximum tensile fiber stress may be reduced by not more than 50 per cent of the direct stress due to vertical dead loads.

(j) **Unreinforced Masonry.** Design and construction of elements of plain masonry shall be such that unit stresses do not exceed those set forth in tables in this Chapter for the various masonry units.

(k) **Reinforced Masonry. 1. Design for construction.** The design and construction of reinforced masonry shall be based on the assumptions, requirements, and methods of stress determination specified for reinforced concrete in Chapter 26, except as specified in this Chapter.

2. **Stresses.** The compressive strength of reinforced masonry assumed for design may be determined by tests as set forth under Section 2404, using as maximum working stresses those set forth under Special Condition in Table No. 24-H. Such working stresses shall be substantiated by test samples of the work as directed by the Building Official.

(l) **Allowable Stresses.** The unit stresses in reinforcement shall not exceed those specified for reinforcement in concrete. Bolt values shall not exceed those set forth in Table No. 24-F.

Bearing  
Walls

Sec. 2418. (a) **General.** Masonry walls shall be designed as specified in Section 2417 and to withstand all vertical and horizontal loads as specified in Chapter 23, and with due allowance for the effect of eccentric loads.

(b) **End Support.** Beams, girders, or other concentrated loads supported by a wall or pier shall have bearing at least three inches (3") in length upon solid masonry not less than four inches (4") thick or upon a metal bearing plate of adequate design and dimensions to distribute the loads safely on the wall or pier, or upon a continuous rein-

forced masonry member projecting not less than three inches (3") from the face of the wall, or by other approved methods.

**Bearing  
Walls  
(Cont'd.)**

Joists shall have bearing at least three inches (3") in length upon solid masonry at least two and one-fourth inches (2¼") thick; or other provisions shall be made to distribute safely the loads on the wall or pier.

(c) **Width in Flexural Computations.** In computing flexural stresses where reinforcement occurs, the effective width shall be not greater than four times the wall thickness in solid masonry nor more than one and one-half times the unit length in hollow masonry.

(d) **Distribution of Concentrated Loads.** The allowable working stresses in bearing directly under concentrated loads may be 50 per cent greater than those given for axial compression in Tables No. 24-G and No. 24-H.

In calculating wall stresses, concentrated loads may be distributed over a maximum length of wall not exceeding the center-to-center distance between loads.

Where the concentrated loads are not distributed through a structural element, the length of wall considered shall not exceed the width of the bearing plus four times the wall thickness.

Concentrated loads shall not be considered as distributed by metal ties, nor distributed across continuous vertical joints.

(e) **Plain Masonry Walls.** 1. **Ratio of height or length to thickness.** The ratio of unsupported height to thickness or the ratio of unsupported length to thickness (one or the other but not both) for solid masonry walls or bearing partitions shall not exceed 20, and shall not exceed 18 for walls of hollow masonry or cavity walls. In computing the ratio for cavity walls, the value for thickness shall be the sum of the nominal thicknesses of the inner and outer widths of the masonry. In walls composed of different kinds or classes of units or mortars, the ratio of height or length to thickness shall not exceed that allowed for the weakest of the combination of units and mortars of which the member is composed.

2. **Minimum thickness.** The minimum thickness of bearing walls of plain masonry shall be twelve inches (12") for the uppermost thirty-five feet (35') of their height, and shall be increased four inches (4") in thickness for each successive thirty-five feet (35') or fraction thereof measured downward from the top of the wall.

**EXCEPTIONS:** 1. The top-story walls of a building not exceeding three stories or thirty-five feet (35') in height, or the walls of a one-story building, may have a wall thickness equal to eight inches (8").

2. The thickness of unreinforced grouted brick masonry walls may be two inches (2") less than required by this Subsection, but in no case less than seven inches (7") except in one-story dwellings.

3. In Group I occupancies not more than three stories in height, masonry walls may be of eight inches (8") nominal

**Bearing  
Walls  
(Cont'd.)**

thickness when not over thirty-five feet (35') in height. Such walls in one-story single-family dwellings and one-story private garages may be of six inches (6") nominal thickness when not over nine feet (9') in height, provided that when gable construction is used an additional six feet (6') is permitted to the peak of the gable.

When a change in thickness due to minimum thickness requirements occurs between floor levels, the greater thickness shall be carried to the higher floor level.

3. **Stresses.** The axial stress in unreinforced bearing walls, or portions thereof, shall not exceed the values set forth in Table No. 24-G. Bolt values shall not exceed those set forth in Table No. 24-F.

(f) **Reinforced Masonry Walls.** 1. **Minimum thickness.** The minimum nominal thickness of reinforced masonry bearing walls shall be six inches (6"), and the ratio of height or length to thickness shall not exceed 25.

2. **Stresses.** The axial stress in reinforced masonry bearing walls shall not exceed the value determined by the following formula:

$$f_m = 0.20 f'_m \left[ 1 - \left( \frac{h}{30t} \right)^2 \right]$$

WHERE:

$f_m$  = Compressive unit axial stress in masonry wall

$f'_m$  = Approved ultimate compressive masonry stress as established in Section 2417 (k) 2.

3. **Reinforcement.** All walls using stress permitted for reinforced masonry shall be reinforced with both vertical and horizontal bars.

The minimum area of total reinforcement shall be not less than 0.002 times the gross cross-sectional area of the wall, not more than two-thirds of which may be used in either direction. Principal wall steel shall be limited to the maximum spacing of four feet (4') on center. The minimum diameter shall be three-eighths inch ( $\frac{3}{8}$ ").

Horizontal reinforcement shall be provided in the top of footings, at the top of wall openings, at roof and floor levels, and at the top of parapet walls. Only horizontal reinforcement which is continuous in the wall shall be considered in computing the minimum area of reinforcement.

If the wall is constructed of more than two units in thickness, the reinforcement shall be equally divided into two layers, except where designed as retaining walls.

**Non-Bearing  
Walls**

**Sec. 2419. (a) General.** Non-bearing walls may be constructed of any masonry as specified in this Chapter.

(b) **Thickness.** Every non-bearing masonry wall shall be so constructed and have a sufficient thickness to withstand all vertical loads and horizontal loads, where specifically required by Chapter 23, but in no case shall the thickness of such walls (including plaster when applied) be less than the values set forth in Table No. 24-I.

(c) **Wire-Mesh Reinforcement.** Wire-mesh reinforcement may be used to resist tensile stresses when embedded in plaster applied to the surface of any non-bearing wall. Wire-mesh reinforcement shall conform to the requirements of Chapter 26, and plaster shall conform to the requirements of Chapter 47.

(d) **Anchorage.** All non-bearing partitions shall be anchored along the top edge to a structural member or a suspended ceiling, or shall be provided with equivalent anchorage along the sides.

All exterior non-bearing walls shall be anchored along all edges to structural members.

**Sec. 2420. (a) General.** Masonry columns shall be constructed of reinforced masonry and as required by this Section. **Columns**

(b) **Limiting Dimensions.** The least dimension of every masonry column shall be not less than twelve inches (12"), unless designed for one-half the allowable stresses, in which case the minimum least dimensions shall be eight inches (8"). No masonry column shall have an unsupported length greater than 20 times its least dimension.

(c) **Allowable Loads.** The maximum axial load on columns shall be computed by the following formula:

$$P = A_g (0.18f'_m + 0.65 p_g f_s) \left[ 1 - \left( \frac{h}{30t} \right)^2 \right]$$

WHERE:

- $P$  = Maximum concentric column axial load
- $A_g$  = The gross area of the column
- $f'_m$  = Approved ultimate compressive masonry stress as established in Section 2417 (k) 2
- $p_g$  = Ratio of the effective cross sectional area of vertical reinforcement to the gross area,  $A_g$
- $f_s$  = See Section 2620 (c)
- $h$  = Unsupported height of column in inches
- $t$  = Thickness of column in inches

(d) **Reinforcement. 1. Vertical Reinforcement.** The ratio ( $p_g$ ) shall be not less than 0.5 per cent nor more than 4 per cent. The number of bars shall be not less than four, nor the diameter less than three-eighths inch ( $\frac{3}{8}$ ").

Where lapped splices are used, the amount of lap shall be sufficient to transfer the working stress by bond, but in no case shall the length of lapped splice be less than 30 bar diameters, and welded splices shall be full butt welded.

**2. Ties.** Lateral ties shall be at least one-fourth inch ( $\frac{1}{4}$ ") in diameter and shall be spaced apart not over 16 bar diameters, 48 tie diameters, or the least dimension of the column. Lateral ties shall be placed not less than one and one-half inches ( $1\frac{1}{2}$ ") and not more than five inches (5") from the surface of the column.

**CHAPTER 25—WOOD****General**

**Sec. 2501. (a) Quality and Design.** The quality and design of wood members and their fastenings used for load-supporting purposes shall conform to the provisions of this Chapter, and to the following standards:

| MATERIALS AND DESIGN                             | U.B.C.<br>DESIGNATION |
|--|-----------------------|
| <b>Softwood Lumber</b> .....                     | <b>25-1</b>           |
| <b>Douglas Fir Plywood</b> .....                 | <b>25-2</b>           |
| <b>Grading</b>                                   |                       |
| All Species of Lumber .....                      | 25-3                  |
| Douglas Fir, Coast Region .....                  | 25-4                  |
| Douglas Fir, Inland Region (Western Pine)...     | 25-5                  |
| Tidewater Red Cypress .....                      | 25-6                  |
| Eastern Hemlock .....                            | 25-7                  |
| West Coast Hemlock .....                         | 25-8                  |
| Larch .....                                      | 25-9                  |
| Red and White Oak .....                          | 25-10                 |
| Southern Pine .....                              | 25-11                 |
| Southern Longleaf Pine .....                     | 25-12                 |
| Redwood .....                                    | 25-13                 |
| <b>Joints</b>                                    |                       |
| Bolted .....                                     | 25-14                 |
| Timber Connector .....                           | 25-15                 |
| Lag-Screw .....                                  | 25-16                 |
| Drift Bolt and Wood Screw .....                  | 25-17                 |
| <b>Structural Glued Laminated Wood</b>           |                       |
| Test for Glue Joints .....                       | 25-18                 |
| All Species of Lumber .....                      | 25-19                 |
| Douglas Fir .....                                | 25-20                 |
| Southern Pine .....                              | 25-21                 |
| Hardwood .....                                   | 25-22                 |
| <b>Built-up Members</b> .....                    | 25-23                 |
| <b>Built-up Columns</b> .....                    | 25-24                 |
| <b>Spaced Columns</b> .....                      | 25-25                 |
| <b>Flat Panels with Stressed Coverings</b> ..... | 25-26                 |
| <b>Wood Poles</b> .....                          | 25-27                 |
| <b>Plank-and-Beam Construction</b> .....         | 25-28                 |
| <b>Flexural and Axial Loading</b> .....          | 25-29                 |
| <b>Adhesives</b> .....                           | 25-30                 |

(b) **Workmanship.** All members shall be framed, anchored, tied, and braced so as to develop the strength and rigidity necessary for the purposes for which they are used.

(c) **Fabrication.** Preparation, fabrication, and installation of wood members, and glues and mechanical devices for the fastening thereof, shall conform to good engineering practices.

**Definitions  
and  
Notations**

**Sec. 2502.** Except where otherwise provided, the following terms and symbols used in this Chapter have the meaning indicated in this Section:



**GLUED LAMINATED LUMBER**, lumber composed of an assembly of wood laminations bonded with adhesives in which the laminations are too thick to be classed as veneers. See definition of Structural Glued Laminated Lumber.

**Definitions  
and  
Notations  
(Cont'd.)**

**GLUED BUILT-UP MEMBERS**, structural members, the sections of which are composed of combinations of sawn lumber or plywood, or glued laminated lumber, in which all parts are bonded together with adhesives.

**GRADE (Lumber)**, the classification of lumber in regard to strength and utility.

**NOMINAL SIZE (Lumber)**, the commercial size designation of width, and depth, in standard sawn lumber and glued laminated lumber grades; somewhat larger than the standard net size of dressed lumber.

**NORMAL LOADING**, a design load that stresses a member or fastening to the full allowable stress tabulated in this Chapter. This loading may be applied for approximately 10 years, either continuously or cumulatively, and 90 per cent of this full maximum design load may be applied for the remainder of the life of the structure.

**STRESS GRADE (Lumber)**, a lumber grade defined in such terms that a definite working stress may be assigned to it as set forth in U.B.C. Standard No. 25-3.

**STRUCTURAL GLUED LAMINATED LUMBER**, any member comprising an assembly of laminations of lumber in which the grain of all laminations is approximately parallel longitudinally; in which the laminations are bonded with adhesives; and which is fabricated in accordance with U.B.C. Standards No. 25-19, No. 25-20, No. 25-21, or No. 25-22.

**SYMBOLS AND NOTATIONS**, as used in these regulations, are defined as follows:

A = area in square inches of net cross section.

b = breadth of beam or of cross section in inches.

c = compression parallel to grain, allowable unit stress in pounds per square inch.

d = least dimension of column, in inches.

E = modulus of elasticity.

f = extreme fiber in bending, allowable unit stress in pounds per square inch.

h = depth of section, in inches.

H = horizontal shear, allowable unit stress in pounds per square inch.

I = moment of inertia of member.

l = span in inches or laterally unsupported length of a column in inches.

N = allowable unit stress on inclined surface in pounds per square inch.

P = total load in pounds.

q = compression perpendicular to grain, allowable unit stress in pounds per square inch.

R = reaction, in pounds.

**TABLE NO. 25-A—ALLOWABLE UNIT STRESSES FOR STRESS-GRADE LUMBER**  
**Normal Loading—See also Sections 2504(d),(e)**

ABBREVIATIONS: J.&P.: Joists and Planks; B.&S.: Beams and Stringers; P.&T.: Posts and Timbers.

| SPECIES AND COMMERCIAL GRADE   |             | ALLOWABLE UNIT STRESSES, POUNDS PER SQ. INCH |  |  |                                |                             |                             |
|--------------------------------|-------------|--|--|--|--------------------------------|-----------------------------|-----------------------------|
|                                |             | Com-<br>pression<br>Parallel to<br>Grain     | Com-<br>pression<br>Perpen-<br>dicular<br>to Grain | Extreme<br>Fiber<br>in Bending<br>(and<br>Tension<br>Parallel to<br>Grain) | Maximum<br>Horizontal<br>Shear | Modulus<br>of<br>Elasticity | Rules under<br>which Graded |
| SYMBOL:                        |             | c  | q  | f or t*  | H                              | E                           |                             |
| DOUGLAS FIR, COAST<br>REGION:  |             |  |  |  |                                |                             | U.B.C. Standard<br>No. 25-4 |
| Dense Select Structural        | J.&P.-B.&S. | 1,550  | 455  | 2,150  | 145                            |                             |                             |
| Select Structural              | J.&P.-B.&S. | 1,450  | 415  | 1,900  | 120                            |                             |                             |
| 1700 f.—Dense No. 1            | J.&P.-B.&S. | 1,325  | 455  | 1,700  | 145                            |                             |                             |
| 1450 f.—No. 1                  | J.&P.-B.&S. | 1,200  | 390  | 1,450  | 120                            |                             |                             |
| 1100 f.—No. 2                  | J.&P.       | 1,075  | 390  | 1,100  | 110                            |                             |                             |
| Dense Select Structural        | P.&T.       | 1,550  | 455  | .....  | .....                          |                             |                             |
| Select Structural              | P.&T.       | 1,450  | 415  | .....  | .....                          |                             |                             |
| Dense No. 1                    | P.&T.       | 1,400  | 455  | .....  | .....                          |                             |                             |
| No. 1                          | P.&T.       | 1,200  | 390  | .....  | .....                          |                             |                             |
| DOUGLAS FIR, INLAND<br>REGION: |             |  |  |  |                                |                             | U.B.C. Standard<br>No. 25-5 |
| Select Structural              | J.&P.       | 1,750  | 455  | 2,150  | 145                            | 1,600,000                   |                             |
| Structural                     | J.&P.       | 1,400  | 400  | 1,900  | 100                            | 1,500,000                   |                             |
| Common Structural              | J.&P.       | 1,250  | 380  | 1,450  | 95                             | 1,500,000                   |                             |
| Select Structural              | P.&T.       | 1,750  | 455  | .....  | .....                          | 1,600,000                   |                             |
| Structural                     | P.&T.       | 1,400  | 400  | .....  | .....                          | 1,500,000                   |                             |
| Common Structural              | P.&T.       | 1,250  | 380  | .....  | .....                          | 1,500,000                   |                             |
| CYPRESS, TIDEWATER RED:        |             |  |  |  |                                |                             | U.B.C. Standard<br>No. 25-6 |
| 1700 f Grade                   | J.&P.-B.&S. | 1,425  |  | 1,700  | 145                            |                             |                             |
| 1300 f Grade                   | J.&P.-B.&S. | 1,125  | 360  | 1,300  | 120                            | 1,200,000                   |                             |
| 1450 c Grade                   | P.&T.       | 1,450  |  | .....  | .....                          |                             |                             |
| 1200 c Grade                   | P.&T.       | 1,200  |  | .....  | .....                          |                             |                             |

\*Members in direct tension shall be so graded as to limit knot size and slope of grain throughout full length of piece as specified for the middle portion in the applicable rules.

TABLE NO. 25-A (Continued)

| SPECIES AND COMMERCIAL GRADE   | ALLOWABLE UNIT STRESSES, POUNDS PER SQ. INCH |  |  |   |                                |                             | Rules under which Graded    |
|--|--|--|--|---|--------------------------------|-----------------------------|-----------------------------|
|  | SYMBOL:                                      | Com-<br>pression<br>Parallel to<br>Grain | Com-<br>pression<br>Perpen-<br>dicular<br>to Grain | Extreme<br>Fiber<br>in Bending<br>(and<br>Tension<br>Parallel to<br>Grain)<br>f or t* | Maximum<br>Horizontal<br>Shear | Modulus<br>of<br>Elasticity |                             |
| HEMLOCK, EASTERN:<br>Select Structural<br>Prime Structural<br>Common Structural<br>Utility Structural<br>Select Structural | J.&P.-B.&S.                                  | 850                                      |  |   |                                |                             |                             |
|  | J.&P.  | 775                                      |  | 1,300   | 85                             |                             |                             |
|  | J.&P.  | 650                                      | 360  | 1,200   | 60                             | 1,100,000                   | U.B.C. Standard<br>No. 25-7 |
|  | J.&P.  | 600                                      |  | 1,100   | 60                             |                             |                             |
|  | P.&T.  | 850                                      |  | 950   | 60                             |                             |                             |
| HEMLOCK, WEST COAST:<br>1600 f.—Select Structural<br>1450 f.—No. 1<br>1100 f.—No. 2<br>No. 1 Hemlock Timbers               | J.&P.-B.&S.                                  | 1,100                                    |  |   |                                |                             |                             |
|  | J.&P.  | 1,075                                    |  | 1,600   | 100                            |                             |                             |
|  | J.&P.  | 850                                      | 360  | 1,450   | 100                            | 1,400,000                   | U.B.C. Standard<br>No. 25-8 |
|  | J.&P.  | 1,075                                    |  | 1,100   | 90                             |                             |                             |
|  | P.&T.  |  |  | .....   | .....                          |                             |                             |
| LARCH:<br>Select Structural<br>Structural<br>Common Structural<br>Select Structural<br>Structural<br>Common Structural     | J.&P.  | 1,750                                    |  |   |                                |                             |                             |
|  | J.&P.  | 1,450                                    | 455  | 2,150   | 145                            |                             |                             |
|  | J.&P.  | 1,325                                    | 415  | 1,900   | 120                            | 1,500,000                   | U.B.C. Standard<br>No. 25-9 |
|  | P.&T.  | 1,750                                    | 455  | .....   | 120                            |                             |                             |
|  | P.&T.  | 1,450                                    | 415  | .....   | .....                          |                             |                             |
|  | P.&T.  | 1,325                                    | 390  | .....   | .....                          |                             |                             |

See Notes page 118.

TABLE NO. 25-A (Continued)

| SPECIES AND COMMERCIAL GRADE   | SYMBOL:     | ALLOWABLE UNIT STRESSES, POUNDS PER SQ. INCH |  |  |                                |                             | Rules under which Graded     |
|--|-------------|--|--|--|--------------------------------|-----------------------------|------------------------------|
|  |             | Com-<br>pression<br>Parallel to<br>Grain     | Com-<br>pression<br>Perpen-<br>dicular<br>to Grain | Extreme<br>Fiber<br>in Bending<br>(and<br>Tension<br>Parallel to<br>Grain) | Maximum<br>Horizontal<br>Shear | Modulus<br>of<br>Elasticity |                              |
|  |             | c  | q  | f or t*  | H                              | E                           |                              |
| OAK, RED AND WHITE:<br>2150 f Grade<br>1900 f Grade<br>1700 f Grade<br>1450 f Grade<br>1300 f Grade<br>1325 c Grade<br>1200 c Grade<br>1075 c Grade  | J.&P.-B.&S. | 1,550  |  | 2,150  | 145                            |                             | U.B.C. Standard<br>No. 25-10 |
|  | J.&P.-B.&S. | 1,375  |  | 1,900  | 145                            |                             |                              |
|  | J.&P.-B.&S. | 1,200  | 600  | 1,700  | 145                            |                             |                              |
|  | J.&P.-B.&S. | 1,050  |  | 1,450  | 120                            |                             |                              |
|  | B.&S.       | 950  |  | 1,300  | 120                            |                             |                              |
|  | P.&T.       | 1,325  |  | .....  | .....                          |                             |                              |
|  | P.&T.       | 1,200  |  | .....  | .....                          |                             |                              |
|  | P.&T.       | 1,075  |  | .....  | .....                          |                             |                              |
| PINE, SOUTHERN:<br>Dense Select Structural<br>Dense Structural<br>Dense Structural S.E.&S.<br>Dense No. 1 Structural<br>No. 1 Dense<br>No. 1<br>No. 2 Dense<br>No. 2<br>Dense Select Structural<br>Dense Structural<br>Dense Structural S.E.&S.<br>Dense No. 1 Structural<br>No. 1 Dense 1400f<br>No. 1 1200f<br>No. 1 Dense 1400f | J.&P.-B.&S. | 1,750  | 455  | 2,400  | 120                            |                             | U.B.C. Standard<br>No. 25-11 |
|  | J.&P.-B.&S. | 1,400  | 455  | 2,000  | 120                            |                             |                              |
|  | J.&P.-B.&S. | 1,300  | 455  | 1,800  | 120                            |                             |                              |
|  | J.&P.-B.&S. | 1,150  | 455  | 1,600  | 120                            |                             |                              |
|  | J.&P.       | 1,400  | 455  | 1,700  | 150                            |                             |                              |
|  | J.&P.       | 1,200  | 390  | 1,450  | 125                            |                             |                              |
|  | J.&P.       | 1,025  | 455  | 1,250  | 100                            |                             |                              |
|  | J.&P.       | 875  | 390  | 1,100  | 85                             |                             |                              |
|  | P.&T.       | 1,750  | 455  | .....  | .....                          |                             |                              |
|  | P.&T.       | 1,400  | 455  | .....  | .....                          |                             |                              |
|  | P.&T.       | 1,300  | 455  | .....  | .....                          |                             |                              |
|  | P.&T.       | 1,150  | 455  | .....  | .....                          |                             |                              |
|  | J.&P.-B.&S. | 1,400  | 455  | 1,400  | 140                            |                             |                              |
|  | J.&P.-B.&S. | 1,200  | 390  | 1,200  | 120                            |                             |                              |
|  | P.&T.       | 1,400  | 455  | 1,400  | 140                            |                             |                              |

See Notes page 118.

TABLE NO. 25-A (Continued)

| SPECIES AND COMMERCIAL GRADE   | SYMBOL:  | ALLOWABLE UNIT STRESSES. POUNDS PER SQ. INCH  |  |   |   |                             | Rules under which Graded     |
|--|--|---|--|---|---|-----------------------------|------------------------------|
|  |  | Com-<br>pression<br>Parallel to<br>Grain  | Com-<br>pression<br>Perpen-<br>dicular<br>to Grain | Extreme<br>Fiber<br>in Bending<br>(and<br>Tension<br>Parallel to<br>Grain)  | Maximum<br>Horizontal<br>Shear  | Modulus<br>of<br>Elasticity |                              |
|  |  | c   | q  | f or t*   | H   | E                           |                              |
| PINE, SOUTHERN (Continued):<br>No. 1 1200f<br>No. 2 Dense 1200f  | P.&T.<br>P.&T.   | 1,200<br>1,025  | 390<br>455   | 1,200<br>1,200  | 120<br>100  | 1,600,000                   | U.B.C. Standard<br>No. 25-11 |
| PINE, SOUTHERN LONGLEAF:<br>Select Structural Longleaf<br>Prime Structural Longleaf<br>Merchantable Structural<br>Longleaf<br>Structural S.E.&S. Longleaf<br>No. 1 Structural Longleaf<br>No. 1 Longleaf<br>No. 2 Longleaf<br>Select Structural Longleaf<br>Prime Structural Longleaf<br>Merchantable Structural<br>Longleaf<br>Structural S.E.&S. Longleaf<br>No. 1 Structural Longleaf<br>No. 1 Longleaf 1400f<br>No. 1 Longleaf 1400f<br>No. 2 Longleaf 1200f | J.&P.-B.&S.<br>J.&P.-B.&S.<br>J.&P.-B.&S.<br>J.&P.-B.&S.<br>J.&P.<br>J.&P.<br>P.&T.<br>P.&T.<br>P.&T.<br>P.&T.<br>P.&T.<br>P.&T.<br>P.&T.<br>J.&P.-B.&S.<br>P.&T.<br>P.&T. | 1,750<br>1,400<br>1,300<br>1,300<br>1,150<br>1,400<br>1,025<br>1,750<br>1,400<br>1,300<br>1,300<br>1,150<br>1,400<br>1,400<br>1,025 | 455  | 2,400<br>2,000<br>1,800<br>1,800<br>1,600<br>1,700<br>1,250<br>.....<br>.....<br>.....<br>.....<br>.....<br>1,400<br>1,400<br>1,200 | 120<br>120<br>120<br>120<br>150<br>100<br>.....<br>.....<br>.....<br>.....<br>140<br>140<br>100 | 1,600,000                   | U.B.C. Standard<br>No. 25-12 |
| REDWOOD:<br>Dense Structural<br>Heart Structural<br>Dense Structural<br>Heart Structural   | J.&P.-B.&S.<br>J.&P.-B.&S.<br>P.&T.<br>P.&T.   | 1,450<br>1,100<br>1,450<br>1,100  | 320  | 1,700<br>1,300<br>.....<br>.....  | 110<br>95<br>.....<br>.....   | 1,200,000                   | U.B.C. Standard<br>No. 25-13 |

See Notes page 118.

**TABLE NO. 25-B--ALLOWABLE UNIT STRESSES FOR PLYWOOD (DOUGLAS FIR)**

In bending, tension, and compression (except bearing and 45-degree stresses)  
consider only those plies with their grain direction parallel  
to the principal stress

| TYPE OF STRESS  | DRY LOCATION           |  |  |  | Interior A-A (So2S)<br>Interior A-B (So/Sld)<br>Interior A-D (SoIS)<br>Interior B-D (Sld/IS)<br>(Apply the following percentages to the stresses for the corresponding Exterior grade.) |
|---|------------------------|--|--|--|---|
|   | Exterior A-A (So2S)    | Exterior A-B (So/Sld)<br>Exterior A-C (SoIS) | Exterior B-C<br>Exterior Sheathing (C-C)<br>Interior Sheathing (C-D)<br>Exterior Concrete Form (B-B)<br>Interior Concrete Form (B-B) |  |   |
| EXTREME FIBER in bending<br>Face grain // to span<br>Face grain ⊥ to span               | 2188<br>1875           | 2000<br>1875                                 | 1875<br>1875   |  | 100%<br>80%   |
| TENSION<br>// to face grain (3-ply only*)<br>⊥ to face grain<br>± 45° to face grain     | 2188<br>1875<br>337    | 2000<br>1875<br>320                          | 1875<br>1875<br>310  |  | 100%**<br>80%<br>85%  |
| COMPRESSION<br>// to face grain (3-ply only*)<br>⊥ to face grain<br>± 45° to face grain | 1605<br>1375<br>496    | 1460<br>1375<br>472                          | 1375<br>1375<br>460  |  | 100%**<br>70%<br>80%  |
| BEARING (on face)   | 405                    | 405  | 405  |  | 100%  |
| SHEAR, rolling, in plane of plies:<br>// or ⊥ to face grain<br>± 45° to face grain      | 79<br>165              | 72<br>96                                     | 68<br>90   |  | 75%<br>75%  |
| SHEAR, in plane ⊥ to plies:<br>// or ⊥ to face grain<br>± 45° to face grain             | 210<br>420             | 192<br>384                                   | 180<br>360   |  | 85%<br>85%  |
| MODULUS OF ELASTICITY<br>in bending<br>Face grain // to span<br>Face grain ⊥ to span    | 1,600,000<br>1,600,000 | 1,600,000<br>1,600,000                       | 1,600,000<br>1,600,000   |  | 100%<br>70%   |

\* For tension or compression, // to grain, in 5-ply or thicker, use values for 3-ply, but in next lower grade.  
\*\* For 5 or more plies use 90%.

## DAMP OR WET LOCATION

Where moisture content will exceed 16 per cent, decrease by 20 per cent values shown for Dry Location for following properties: Extreme Fiber in Bending, Tension and Compression both parallel and perpendicular to grain and at 45 degrees, and Bearing. (No change in values for shear or modulus of elasticity.)  
Only Exterior Type plywood should be used where moisture content will exceed 18 per cent.

**TABLE NO. 25-C—ALLOWABLE UNIT STRESSES—STRUCTURAL GLUED LAMINATED DOUGLAS FIR  
(COAST REGION), AND SOUTHERN PINE LUMBER DRY CONDITIONS OF USE**  
Allowable unit stresses are for normal conditions of loading, pounds per square inch.

| COMBINATION<br>NUMBER | SPECIES AND COMMERCIAL<br>GRADE COMBINATION     |                                   |                                       | EXTREME FIBER<br>IN BENDING "f"     |                                   | TENSION<br>PARALLEL<br>TO GRAIN<br>"t" |                                   | COMPRESSION<br>PARALLEL TO<br>GRAIN "c" |                                   | HORI-<br>ZONTAL<br>SHEAR<br>"H" | COMPRES-<br>SION PER-<br>PENDICU-<br>LAR TO<br>GRAIN<br>"q" |
|-----------------------|---|-----------------------------------|---------------------------------------|-------------------------------------|-----------------------------------|--|-----------------------------------|---|-----------------------------------|---------------------------------|---|
|                       | 1   | 2                                 | 3                                     | 4                                   | 5                                 | 6                                      | 7                                 | 8                                       | 9                                 |                                 |   |
|                       | Grade of<br>Laminations<br>at Top and<br>Bottom | Number<br>at Top<br>and<br>Bottom | Grade<br>of Inner<br>Lamina-<br>tions | From 4<br>to 14<br>Lamina-<br>tions | 15 or<br>More<br>Lamina-<br>tions | From 4<br>to 14<br>Lamina-<br>tions    | 15 or<br>More<br>Lamina-<br>tions | From 4<br>to 14<br>Lamina-<br>tions     | 15 or<br>More<br>Lamina-<br>tions |                                 |   |
| DOUGLAS FIR           |   |                                   |                                       |                                     |                                   |  |                                   |   |                                   |                                 |   |
| 1                     | Clear (Dense)*                                  | One                               | Dense Select<br>Structural            | 3000                                | 3000                              | 3000                                   | 3000                              | 2400                                    | 2500                              | 165                             | 455   |
| 2                     | Clear (Dense)*                                  | One                               | Dense No. 1                           | 3000                                | 3000                              | 2600                                   | 3000                              | 2200                                    | 2300                              | 165                             | 455   |
| 3                     | Dense Select                                    | All                               | Dense Select<br>Structural            | 2800                                | 3000                              | 3000                                   | 3000                              | 2400                                    | 2500                              | 165                             | 455   |
| 4                     | Clear (Close-<br>Grain)*                        | One                               | Select<br>Structural                  | 2800                                | 2800                              | 2800                                   | 2800                              | 2200                                    | 2200                              | 165                             | 415   |
| 5                     | Select  | All                               | Select<br>Structural                  | 2600                                | 2800                              | 2800                                   | 2800                              | 2200                                    | 2200                              | 165                             | 415   |
| 6                     | Structural                                      | 1/5 of<br>total                   | Select<br>No. 1                       | 2600                                | 2800                              | 2400                                   | 2600                              | 2000                                    | 2000                              | 165                             | 415   |
| 7                     | Clear (Medium<br>Grain)*                        | One                               | No. 1                                 | 2600                                | 2600                              | 2200                                   | 2400                              | 1900                                    | 2000                              | 165                             | 390   |
| 8                     | Dense No. 1                                     | All                               | Dense No. 1                           | 2400                                | 2600                              | 2600                                   | 3000                              | 2200                                    | 2300                              | 165                             | 455   |
| 9                     | Dense No. 1                                     | 1/14 of<br>total                  | No. 1                                 | 2400                                | 2600                              | 2200                                   | 2400                              | 1900                                    | 2000                              | 165                             | 455   |
| 10                    | Select  | One                               | No. 1                                 | 2400                                | 2600                              | 2200                                   | 2400                              | 1900                                    | 2000                              | 165                             | 415   |
| 11                    | Structural                                      | 1/5 of<br>total                   | No. 2                                 | 2200                                | 2600                              | 2400                                   | 2600                              | 1900                                    | 2000                              | 165                             | 415   |
| 12                    | Clear (Medium<br>Grain)*                        | One                               | No. 2                                 | 2200                                | 2200                              | 2000                                   | 2400                              | 1800                                    | 1900                              | 165                             | 390   |
| 13                    | Select  | One                               | No. 2                                 | 2200                                | 2200                              | 2000                                   | 2400                              | 1800                                    | 1900                              | 165                             | 415   |
| 14                    | Structural                                      | All                               | No. 1                                 | 2000                                | 2200                              | 2200                                   | 2400                              | 1900                                    | 2000                              | 165                             | 390   |
| 15                    | No. 1   | One                               | No. 2                                 | 2000                                | 2200                              | 2000                                   | 2400                              | 1800                                    | 1900                              | 165                             | 390   |
| 16                    | No. 2   | All                               | No. 2                                 | 1600                                | 2000                              | 2000                                   | 2400                              | 1800                                    | 1900                              | 165                             | 390   |

(Continued)

**TABLE NO. 25-C (Continued)**

| COMBINATION<br>NUMBER | SPECIES AND COMMERCIAL<br>GRADE COMBINATION     |                                   |                                       | EXTREME FIBER<br>IN BENDING "f"     |                                   | TENSION<br>PARALLEL<br>TO GRAIN<br>"t" |                                   | COMPRESSION<br>PARALLEL TO<br>GRAIN "c" | HORI-<br>ZONTAL<br>SHEAR<br>"H" | COMPRE-<br>SION PER-<br>PENDICU-<br>LAR TO<br>GRAIN<br>"q" |     |
|-----------------------|---|-----------------------------------|---------------------------------------|-------------------------------------|-----------------------------------|--|-----------------------------------|---|---------------------------------|--|-----|
|                       | 1   | 2                                 | 3                                     | 4                                   | 5                                 | 6                                      | 7                                 |   |                                 |  |     |
|                       |   |                                   |                                       |                                     |                                   |  |                                   |   |                                 |  |     |
|                       | Grade of<br>Laminations<br>at Top and<br>Bottom | Number<br>at Top<br>and<br>Bottom | Grade<br>of Inner<br>Lamina-<br>tions | From 4<br>to 14<br>Lamina-<br>tions | 15 or<br>More<br>Lamina-<br>tions | From 4<br>to 14<br>Lamina-<br>tions    | 15 or<br>More<br>Lamina-<br>tions | 8                                       | 9                               | 10   | 11  |
| SOUTHERN PINE         |   |                                   |                                       |                                     |                                   |  |                                   |   |                                 |  |     |
| 1                     | No. 1 Dense                                     | All                               | No. 1 Dense                           | 3000                                | 3000                              | 3000                                   | 3000                              | 2400                                    | 2500                            | 200  | 450 |
| 2                     | B&B Dense                                       | One                               | No. 1                                 | 3000                                | 3000                              | 2600                                   | 2600                              | 2100                                    | 2100                            | 200  | 450 |
| 3                     | No. 1 Dense                                     | 1/14 of<br>total                  | No. 1                                 | 3000                                | 3000                              | 2600                                   | 2600                              | 2100                                    | 2100                            | 200  | 450 |
| 4                     | B&B Dense                                       | One                               | No. 2 Dense                           | 2800                                | 2800                              | 3000                                   | 3000                              | 2400                                    | 2400                            | 200  | 450 |
| 5                     | No. 1 Dense                                     | 1/5 of<br>total                   | No. 2 Dense                           | 2800                                | 3000                              | 2800                                   | 3000                              | 2300                                    | 2400                            | 200  | 450 |
| 6                     | No. 1   | All                               | No. 1                                 | 2600                                | 2600                              | 2600                                   | 2600                              | 2100                                    | 2100                            | 200  | 385 |
| 7                     | B&B Dense                                       | 1/14 of<br>total                  | No. 2                                 | 2400                                | 2800                              | 2600                                   | 2600                              | 2000                                    | 2000                            | 200  | 450 |
| 8                     | B&B   | One                               | No. 2                                 | 2400                                | 2400                              | 2600                                   | 2600                              | 2000                                    | 2000                            | 200  | 385 |
| 9                     | No. 1   | 1/5 of<br>total                   | No. 2                                 | 2400                                | 2600                              | 2400                                   | 2600                              | 2000                                    | 2000                            | 200  | 385 |
| 10                    | No. 2 Dense                                     | total                             | No. 2 Dense                           | 2000                                | 2600                              | 2600                                   | 3000                              | 2200                                    | 2300                            | 200  | 450 |
| 11                    | No. 2 Dense                                     | All                               | No. 2                                 | 2000                                | 2600                              | 2200                                   | 2600                              | 1900                                    | 2000                            | 200  | 450 |
| 12                    | No. 2   | 1/14 of<br>total<br>All           | No. 2                                 | 1800                                | 2200                              | 2200                                   | 2600                              | 1900                                    | 2000                            | 200  | 385 |

NOTES: Modulus of elasticity, "E," dry conditions of use, 1,800,000.

Allowable stress values for dry conditions of use shall be applicable for normal loading when the moisture content in service is less than 15 per cent as in most covered structures.

For wet conditions of use, the following maximum percentages of Dry Use Stresses shall be permitted:

"f" (bending) and "t" (tension) 80%

"H" (horizontal shear) and "M" (modulus of elasticity) 90%

"c" and "q" (compression parallel and perpendicular) 70%

\*The rate of growth and density requirements of inner laminations shall apply to clear outer laminations.



TABLE NO. 25-D—PART A—ALLOWABLE UNIT STRESSES FOR GLUED HARDWOOD LAMINATED LUMBER FOR NORMAL LOADING DURATION—DRY CONDITION OF USE\*

| SPECIES  | MULTIPLY THE APPROPRI-<br>ATE STRESS MODULE IN<br>PART B BY THE FACTORS<br>BELOW TO DETERMINE<br>ALLOWABLE STRESS FOR |  |                            | ALLOWABLE UNIT STRESS<br>(Pounds per Square Inch) |                              |  |
|--|---|--|----------------------------|---|------------------------------|--|
|  | Extreme Fiber in<br>Bending "f" or<br>Tension Parallel to<br>Grain "t"  | Compression<br>Parallel<br>to Grain<br>"c" | Horizontal<br>Shear<br>"H" | Compression<br>Perpendicular<br>to Grain<br>"q"   | Modulus of<br>Elasticity "E" |  |
| Hickory, true and pecan.....                           | 3.90  | 3.05                                       | 260                        | 730   | 2,000,000                    |  |
| Beech, American.....                                   | 3.05  | 2.45                                       | 230                        | 610   | 1,800,000                    |  |
| Birch, sweet and yellow.....                           | 3.05  | 2.45                                       | 230                        | 610   | 1,800,000                    |  |
| Elm, rock.....   | 3.05  | 2.45                                       | 230                        | 610   | 1,400,000                    |  |
| Maple, black and sugar (hard maple).....               | 3.05  | 2.45                                       | 230                        | 610   | 1,800,000                    |  |
| Ash, commercial white.....                             | 2.85  | 2.20                                       | 230                        | 610   | 1,600,000                    |  |
| Oak, commercial red and white.....                     | 2.85  | 2.05                                       | 230                        | 610   | 1,600,000                    |  |
| Elm, American and slippery (white or<br>soft elm)..... | 2.20  | 1.60                                       | 190                        | 310   | 1,300,000                    |  |
| Sweet gum (red or sap gum).....                        | 2.20  | 1.60                                       | 190                        | 370   | 1,300,000                    |  |
| Tupelo, black (black gum).....                         | 2.20  | 1.60                                       | 190                        | 370   | 1,300,000                    |  |
| Tupelo, water.....                                     | 2.20  | 1.60                                       | 190                        | 370   | 1,300,000                    |  |
| Ash, black.....  | 2.00  | 1.30                                       | 170                        | 370   | 1,200,000                    |  |
| Poplar, yellow.....                                    | 1.80  | 1.45                                       | 150                        | 270   | 1,200,000                    |  |
| Cottonwood, Eastern.....                               | 1.55  | 1.20                                       | 110                        | 180   | 1,100,000                    |  |

TABLE NO. 25-D—PART B—VALUES FOR USE IN COMPUTING WORKING STRESSES WITH THE FACTORS OF PART A TOGETHER WITH LIMITATIONS REQUIRED TO PERMIT THE USE OF SUCH STRESSES<sup>1</sup>

| RATIO OF SIZE OF MAXIMUM PERMITTED KNOT TO FINISHED WIDTH OF LAMINATION <sup>2</sup> | NUMBER OF LAMINATIONS | EXTREME FIBER IN BENDING |                      |                      |  | TENSION PARALLEL TO GRAIN |                      |                      |  | COMPRESSION PARALLEL TO GRAIN |                      |
|--|-----------------------|--------------------------|----------------------|----------------------|--|---------------------------|----------------------|----------------------|--|-------------------------------|----------------------|
|  |                       | Stress Module            | Steepest Grain Slope | Steepest Scarf Slope |  | Stress Module             | Steepest Grain Slope | Steepest Scarf Slope |  | Stress Module                 | Steepest Grain Slope |
| 0.1  | 4 to 14               | 800                      | 1:16                 | 1:10                 |  | 800                       | 1:16                 | 1:10                 |  | 970                           | 1:15                 |
| .1   | 15 or more            | 800                      | 1:16                 | 1:10                 |  | 800                       | 1:16                 | 1:10                 |  | 980                           | 1:15                 |
| .2   | 4 to 14               | 800                      | 1:16                 | 1:10                 |  | 800                       | 1:16                 | 1:10                 |  | 930                           | 1:15                 |
| .2   | 15 or more            | 800                      | 1:16                 | 1:10                 |  | 800                       | 1:16                 | 1:10                 |  | 950                           | 1:15                 |
| .3   | 4 to 14               | 670                      | 1:12                 | 1:8                  |  | 800                       | 1:16                 | 1:10                 |  | 870                           | 1:15                 |
| .3   | 15 or more            | 770                      | 1:16                 | 1:10                 |  | 800                       | 1:16                 | 1:10                 |  | 900                           | 1:15                 |
| .4   | 4 to 14               | 520                      | 1:8                  | 1:5                  |  | 640                       | 1:12                 | 1:8                  |  | 810                           | 1:12                 |
| .4   | 15 or more            | 660                      | 1:12                 | 1:8                  |  | 750                       | 1:15                 | 1:8                  |  | 860                           | 1:14                 |
| .5   | 4 to 14               | 390                      | 1:8                  | 1:5                  |  | 480                       | 1:8                  | 1:5                  |  | 730                           | 1:10                 |
| .5   | 15 or more            | 550                      | 1:10                 | 1:15                 |  | 630                       | 1:12                 | 1:8                  |  | 800                           | 1:12                 |

1. The allowable unit stresses in bending obtained from Table No. 25-D apply when the wide faces of the lamination are normal to the direction of the load.
2. Factors for knot sizes of 0.1 and 0.2 are identical in case of extreme fiber in bending and in tension parallel to grain because a slope of grain of 1:16 is a greater limitation than knot size. The smaller knot size may be specified for reasons other than strength.
3. Allowable stresses for dry conditions of use shall be applicable when the moisture content in service is less than 15 per cent, as in most covered structures. For wet conditions of use the following maximum percentage of the dry use stresses shall be permitted:  
 "f" (bending) and "t" (tension) 80%  
 "H" (horizontal shear) and "E" (modulus of elasticity) 90%  
 "c" (compression parallel to grain) 70%  
 "q" (compression perpendicular to grain) 67%
4. For modification of allowable unit stresses for structural glued laminated lumber see Section 2504.

|  |  |
|--|--|
| $t$ = tension parallel to grain, allowable unit stress in pounds per square inch.  | <b>Definitions and Notations (Cont'd.)</b> |
| $V$ = vertical shear at section under consideration.                               |  |
| $l/d$ = ratio of length to least dimension.  |  |
| $P/A$ = compressive strength or maximum axial load, in pounds per square inch.     |  |
| $\theta$ = angle between direction of load and the direction of grain, in degrees. |  |

**Sec. 2503. (a) Required Sizes.** Wood members shall be of sufficient size to carry the dead and required live loads without exceeding the allowable unit stresses as hereinafter specified. **Size of Structural Members**

(b) **Size Determination.** Minimum sizes of lumber members required by this Code refer to nominal sizes. U.B.C. Standards No. 25-1, No. 25-20, No. 25-21, and No. 25-22 dressed sizes shall be accepted as the minimum net sizes conforming to nominal sizes. Nominal sizes may be shown on the plans. Computations to determine the required sizes of members shall be based on the net dimensions (actual sizes) and not the nominal sizes. If rough sizes or sizes or shapes other than U.B.C. Standards No. 25-1, No. 25-19, No. 25-20, No. 25-21, and No. 25-22 dressed sizes are to be used, the actual net sizes shall be specified on the plans.

**Sec. 2504. (a) Allowable Unit Stress on Plans.** Where structures are designed for use of stress grade lumber, structural glued laminated lumber, or plywood used structurally, the allowable unit stresses or the species and the grade shall be shown on the plans filed with the building department. **Allowable Unit Stresses**

(b) **Stresses. 1. General.** Except as hereinafter provided, stresses shall not exceed the allowable unit stresses in pounds per square inch for the respective species and grades and grade combinations as set forth in Table No. 25-A for solid sawn stress-grade lumber; Table No. 25-B for Douglas fir plywood; and Tables No. 25-C and No. 25-D for structural glued laminated lumber.

For modification of allowable unit stresses for structural glued laminated lumber, see also Section 2513.

The allowable unit stresses in extreme fiber in bending "f" as set forth in Tables No. 25-C and No. 25-D apply to members with the wide face of the lamination perpendicular to the direction of the load. When the wide face of the lamination is parallel to the direction of the load, the bending stresses as set forth in Table No. 25-A shall apply.

The allowable unit stresses as set forth in Tables No. 25-A, No. 25-C, and No. 25-D and adjustments thereof, and stresses as set forth in Table No. 25-B, apply also to lumber, to structural glued laminated lumber, and to exterior type plywood that have been pressure-impregnated by an approved preservative.

Studding, posts, joists, rafters, planks, beams, stringers, and similar load-bearing members shall be not less in grade than 1100 f or No. 2 Douglas fir or Southern pine, or comparable grades in other species.

Stresses for grades and species other than those tabulated shall be established by the Building Official; for sawn

**Allowable  
Unit  
Stresses  
(Cont'd.)**

lumber when determined in accordance with U.B.C. Standard No. 25-3; and for species and grade combinations used in structural glued laminated lumber when determined in accordance with U.B.C. Standard No. 25-19.

Allowable unit stresses of plywood other than Douglas fir shall be determined according to the species.

**2. Stresses in poles or piles used as structural members.** Induced stresses in pounds per square inch for normal loading of round poles or piles when used as structural members, except modulus of elasticity which shall be the same as for sawn lumber, shall not exceed 60 per cent of the basic unit working stresses for clear lumber for the species as set forth in U.B.C. Standard No. 25-3, and the pieces shall meet the requirements of U.B.C. Standard No. 25-27 for poles or U.B.C. Standard No. 28-1 for piles.

(c) **Identification.** All stresses that exceed those set forth in Table No. 25-A for the lowest structural grade of any species shall be used only when the higher grade of that species is identified by a grade-mark of, or certificate of inspection issued by, a lumber-grading or inspection bureau or an approved inspection agency.

All plywood when used structurally, including, among others, use for siding, roof and wall sheathing, subflooring, diaphragms, and built-up beams, shall conform to performance standards for its type in U.B.C. Standard No. 25-2; it shall be identified as to grade and glue type by an approved agency. In addition to the above requirements all plywood when permanently exposed in outdoor applications shall be of exterior type.

The allowable unit stresses for structural glued laminated lumber as set forth in U.B.C. Standard No. 25-19 and in Tables No. 25-C and No. 25-D shall be used only when the material and workmanship are in accordance with U.B.C. Standards No. 25-19, No. 25-20, No. 25-21, or No. 25-22, respectively, and are inspected and identified in a manner meeting the approval of the Building Official.

(d) **Conditions of Service.** The allowable unit stresses as set forth in Table No. 25-A and adjustments thereof apply to lumber used under conditions continuously dry, such as in most covered structures. Under such conditions of use the modulus of elasticity may be increased 10 per cent for lumber that is surface seasoned before loading to the maximum allowable load. Except for compression parallel and compression perpendicular to the grain, they also apply to lumber used under conditions where the moisture content of the wood is permanently at or above the fiber saturation point, as when continuously submerged.

When used under continuously wet conditions, the allowable unit stresses as set forth in Table No. 25-A for compression parallel to grain shall be reduced 10 per cent and for compression perpendicular to the grain shall be reduced one-third.

The allowable unit stresses as set forth in Tables No. 25-A, No. 25-C, and No. 25-D and adjustments thereof

apply to sawn lumber and to structural glued laminated lumber that has been pressure-impregnated by an approved process and to the heartwood of durable species under dry or other conditions of use.

The allowable unit stresses for structural glued laminated lumber as set forth in Tables No. 25-C and No. 25-D shall be for dry conditions of use where the moisture content in service is less than 15 per cent, as in most covered structures. For wet conditions of use, the maximum percentage of the dry-use stress permitted shall be as indicated in the footnotes applicable to the respective tables.

**Allowable  
Unit  
Stresses  
(Cont'd.)**

(e) **Adjustment of Allowable Unit Stresses for Duration of Load.** The allowable unit stresses as set forth in Table No. 25-A for sawn lumber and Tables No. 25-C and No. 25-D for structural glued laminated lumber, and the values for mechanical fastenings as hereinafter established, shall be applicable as follows for the various durations of loading:

1. Where a member is fully stressed to the maximum allowable stress, either continuously or cumulatively for more than 10 years under the condition of maximum design load, the allowable unit stresses used in the design shall not exceed 90 per cent of those in the tables.

2. When the duration of the full maximum load does not exceed the period indicated below, increase the allowable unit stresses in the tables as follows:

- 15 per cent for two months duration, as for snow
- 25 per cent for seven days duration
- 33 1/3 per cent for wind or earthquake
- 100 per cent for impact

Allowable unit stresses given in the tables for normal loading conditions may be used without regard to impact if the stress induced by impact does not exceed the allowable unit stress for normal loading.

The above increases are not cumulative. For combined durations of loading, the resulting structural members shall not be smaller than required for a longer duration of loading.

(f) **Horizontal Shear Adjustment.** The unit stress in horizontal shear in members of rectangular section stressed in flexure shall be computed by use of the following formula:

$$H = \frac{3 R}{2 b h}$$

WHERE:

R = reaction, pounds, under the following conditions:

- (1) Distribution of load to adjacent beams through flooring or other members shall be considered.
- (2) All loads uniform or concentrated, within a distance of the height of the beam from the nearest support, shall be neglected.
- (3) All concentrated loads located at a distance from the support of one to three times the height of the beam shall be considered as placed at three times the height of the beam from the support.

**Allowable  
Unit  
Stresses  
(Cont'd.)**

(g) **Adjustments of Allowable Unit Stresses for Joint Details.** 1. **Compression.** In joists supported on a ribbon or ledger board and spiked to the studding, the allowable stress in compression perpendicular to the grain may be increased 50 per cent.

Allowable unit stresses in compression perpendicular to grain as set forth in Table No. 25-A shall be increased in accordance with the following factors for bearing less than six inches (6") in length and located three inches (3") or more from the end of a timber.

| Length of bearing<br>(inches) | ½    | 1    | 1½   | 2    | 3    | 4    | 6 or more |
|-------------------------------|------|------|------|------|------|------|-----------|
| Factor                        | 1.75 | 1.38 | 1.25 | 1.19 | 1.13 | 1.10 | 1.00      |

For stress under washers or small plates the same factor may be taken as for a bearing, the length of which equals the diameter of the washer.

2. **Shear.** Allowable unit stresses in shear for joint details shall be 150 per cent of the horizontal shear values as set forth in Tables No. 25-A, No. 25-C, and No. 25-D.

In computing the horizontal shear in eccentric joints the effective depth of the member shall be assumed as its actual depth less the distance from the unloaded edge to the nearest edge of the nearest connector. Where bolts alone are used, subtract the distance from the unloaded edge to the center of the nearest bolt.

(h) **Holes and Notches.** Girders, beams, or joists may be notched or bored in any part of the section within three times the beam depth from either support. Such notches or holes shall not exceed one-fifth of the depth of beam except at point of support and as hereinafter provided.

Where girders, beams, or joists are notched at points of support, they shall meet design requirements for net section in bending and in shear. The shear at such point shall not exceed the value calculated by the following formula:

$$V = \frac{2}{3} \left( \frac{bd'' H}{h} \right)$$

WHERE:

d = actual depth of beam at the notch  
h = total depth of beam.

Where notches or holes are made in other portions of the beam, the net remaining depth of beam shall be used in determining the bending strength.

(i) **Compression on Inclined Surfaces.** The unit stress (compression) normal to a plane inclined to the fiber of a wood member shall not exceed that determined from the formula:

$$N = \frac{c q}{c \sin^2 \theta + q \cos^2 \theta}$$

**Sec. 2505.** Columns, posts, struts, and other members in **Columns** compression parallel to grain shall be designed structurally as provided in this Section.

(a) **Solid Columns.** Simple solid wood columns consist of a single piece of sawn lumber or structurally glued laminated lumber.

The safe load in pounds per square inch of net cross-sectional area, for simple columns or other solid members stressed in compression parallel to the grain, shall be determined by the following formula:

$$P/A = \frac{0.3 E}{(l/d)^2}$$

but the maximum unit load ( $P/A$ ) shall not exceed the allowable unit stress in compression parallel to grain (c) as set forth in Tables No. 25-A, No. 25-C, and No. 25-D.

Columns shall be limited in maximum length between points of lateral support to  $l = 50d$ , except that the individual members of spaced columns shall be limited in maximum length to  $l = 80d$ .

The safe load on a solid column of round cross section shall not exceed that permitted for a square column of the same cross-sectional area.

The safe load on a simple solid column of other than rectangular or round cross section shall be determined by the following formula:

$$P/A = \frac{\pi^2 E}{2.727 (l/r)^2}$$

WHERE:

$r$  = least radius of gyration of the section.

(b) **Multiple Member Columns or Compression Members.**

1. **Spaced columns.** Spaced columns or compression members shall be based upon design principles acceptable to the Building Official, or the design principles set forth for spaced columns in U.B.C. Standard No. 25-25.

2. **Built-up columns.** Built-up columns composed of two or more members spiked or bolted together shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-24.

(c) **Combined Flexural and Axial Loading.** Members subjected to both flexure and axial loading shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-29.

**Sec. 2506.** (a) **Timber Connectors.** Timber connectors may be used to transmit stress between wood members and between wood and metal members. The allowable loads and installation of timber connectors shall be as set forth in U.B.C. Standard No. 25-15. **Timber Connections and Fastenings**

Safe loads and design practices for types of connectors not mentioned or fully covered in U.B.C. Standard No. 25-15 may be determined in a manner approved by the Building Official.

**TABLE NO. 25-E—HOLDING POWER OF BOLTS**  
**Loads Parallel to Grain (p)**

| LENGTH OF BOLT<br>IN MAIN MEM-<br>BER* (Inches) | DIAMETER OF BOLT (Inches) |      |      |      |      |      |      |
|---|---------------------------|------|------|------|------|------|------|
|   | ½                         | ⅝    | ¾    | ⅞    | 1    | 1⅛   | 1¼   |
| 1⅝  | 833                       | 1050 | 1270 | 1480 | 1690 |      |      |
| 2⅝  | 1040                      | 1540 | 1980 | 2360 | 2720 |      |      |
| 3⅝  | 1050                      | 1640 | 2340 | 3020 | 3620 |      |      |
| 4½  | 1050                      | 1640 | 2360 | 3210 | 4060 | 4860 |      |
| 5½  |                           | 1640 | 2360 | 3210 | 4180 | 5240 |      |
| 6½  |                           | 1640 | 2360 | 3210 | 4190 | 5330 |      |
| 7½  |                           | 1640 | 2360 | 3210 | 4190 | 5340 |      |
| 9½  |                           |      | 2360 | 3210 | 4190 | 5340 | 6550 |
| 11½   |                           |      |      |      | 4190 | 5340 | 6550 |

\* This assumes dressed size lumber. Safe loads for other lengths of bolt in main member may be obtained by interpolation.

**Timber  
Connections  
and  
Fastenings  
(Cont'd.)**

(b) **Bolts.** Bolted joints wherein bolts are used to resist or transfer stresses in wood structures shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-14. Safe loads in pounds for bolts in double shear and in seasoned lumber of the following species: cedar, eastern red; cypress, southern; Douglas fir (coast region); larch, western; pine, southern yellow; redwood and tamarack, in joints consisting of three members in which the side members are one-half the thickness of the main member, shall not exceed values set forth in Tables No. 25-E and No. 25-F. (For other species see U.B.C. Standard No. 25-14.)

(c) **Drift Bolts or Pins.** Connections of wood structural members involving the use of drift bolts or drift pins shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-17.

(d) **Lag Screws.** Connections involving the use of lag screws shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-16.

(e) **Wood Screws.** Connections involving the use of wood screws shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-17.

(f) **Nails and Spikes.** 1. **Safe lateral strength.** A common wire nail driven perpendicular to the grain of the wood, when used to fasten wooden members together, shall not be subjected to a greater load causing shear and bending than the safe lateral strength of the wire nail or spike as set forth in Table No. 25-G.

A wire nail driven parallel to the grain of the wood or toe nailed shall not be subjected to more than two-thirds of the lateral load allowable when driven perpendicular to the grain.

2. **Safe resistance to withdrawal.** A wire nail driven perpendicular to the grain of the wood shall not be subjected to a greater load, tending to cause withdrawal, than the safe resistance of the nail to withdrawal, as set forth in Table No. 25-H.



**TABLE NO. 25-F—HOLDING POWER OF BOLTS**  
**Loads Perpendicular to Grain (q)**

| LENGTH OF BOLT<br>IN MAIN MEM-<br>BER* (Inches) | DIAMETER OF BOLT (Inches) |      |      |      |      |      |      |
|---|---------------------------|------|------|------|------|------|------|
|   | ½                         | ⅝    | ¾    | ⅞    | 1    | 1⅛   | 1¼   |
| 1⅝  | 383                       | 416  | 466  | 516  | 566  |      |      |
| 2⅝  | 600                       | 690  | 757  | 840  | 916  |      |      |
| 3⅝  | 800                       | 950  | 1050 | 1160 | 1270 |      |      |
| 4½  | 800                       | 1130 | 1310 | 1440 | 1570 | 1710 |      |
| 5½  |                           | 1130 | 1510 | 1760 | 1920 | 2090 |      |
| 6½  |                           | 1080 | 1520 | 1970 | 2250 | 2470 |      |
| 7½  |                           | 1020 | 1470 | 1950 | 2430 | 2830 |      |
| 9½  |                           |      | 1310 | 1830 | 2380 | 3030 | 3590 |
| 11½   |                           |      |      |      | 2240 | 2880 | 3520 |

\* This assumes dressed size lumber. Safe loads for other lengths of bolt in main member may be obtained by interpolation.

**TABLE NO. 25-G—SAFE LATERAL STRENGTH AND  
 REQUIRED PENETRATION OF COMMON  
 WIRE NAILS**

**Driven Perpendicular to the Grain of the Wood**

| SIZE<br>OF<br>NAIL | STAND-<br>ARD<br>LENGTH<br>(Inches) | WIRE<br>GAUGE | PENE-<br>TRATION<br>RE-<br>QUIRED<br>(Inches) | LOADS (Pounds)                                |              |  |
|--------------------|-------------------------------------|---------------|---|---|--------------|--|
|                    |                                     |               |   | DOUGLAS<br>FIR<br>OR<br>SOUTH-<br>ERN<br>PINE | RED-<br>WOOD | OTHER<br>SPECIES                               |
| 6d                 | 2                                   | 11½           | 1   | 70  | 58           | As<br>determined<br>by<br>Building<br>Official |
| 8d                 | 2½                                  | 10¼           | 1¼  | 100   | 82           |  |
| 10d                | 3                                   | 9             | 1½  | 120   | 98           |  |
| 12d                | 3¼                                  | 9             | 1⅝  | 130   | 106          |  |
| 16d                | 3½                                  | 8             | 1⅝  | 160   | 123          |  |
| 20d                | 4                                   | 6             | 2   | 190   | 155          |  |
| 30d                | 4½                                  | 5             | 2¼  | 230   | 188          |  |
| 40d                | 5                                   | 4             | 2½  | 270   | 220          |  |
| 50d                | 5½                                  | 3             | 2¾  | 310   | 250          |  |
| 60d                | 6                                   | 2             | 3   | 360   | 295          |  |

**TABLE NO. 25-H—SAFE RESISTANCE TO WITH-  
 DRAWAL OF COMMON WIRE NAILS**

**Inserted Perpendicular to the Grain of the Wood, in Pounds  
 per Linear Inch of Penetration into the Main Member**

| KIND OF<br>WOOD                               | SIZE OF NAIL                           |    |     |     |     |     |     |     |     |     |
|---|--|----|-----|-----|-----|-----|-----|-----|-----|-----|
|   | 6d                                     | 8d | 10d | 12d | 16d | 20d | 30d | 40d | 50d | 60d |
| Douglas Fir or<br>Southern Pine<br>or Redwood | 27                                     | 29 | 35  | 35  | 39  | 48  | 52  | 56  | 61  | 67  |
| Other Species                                 | As determined by the Building Official |    |     |     |     |     |     |     |     |     |

TABLE NO. 25-I—NUMBER OF NAILS FOR  
CONNECTING WOOD MEMBERS

## Group I and J Occupancies

| CONNECTION                         | BOX OR COMMON |
|------------------------------------|---------------|
| Joist to sill or girder—toe nail   | 2-16d         |
| Bridging to joist—toe nail         | 2- 8d         |
| 1x6 subfloor to joist—face nail    | 2- 8d         |
| 2-inch subfloor to joist or girder | 2-16d         |
| Plate to joist or blocking         | 16d-16" o/c   |
| Stud to plate—end nail             | 2-16d         |
| Stud to plate—toe nail             | 3-16d or 4-8d |
| Top plates—spike together          | 16d-24" o/c   |
| —laps and intersections            | 2-16d         |
| Ceiling joists—to plate—toe nail   | 2-16d         |
| —laps over partitions              | 3-16d         |
| —to parallel alternate<br>rafters  | 3-16d         |
| Rafter to plate                    | 3-16d         |
| Continuous 1-inch brace to stud    | 2- 8d         |
| 2-inch cut-in bracing to stud      | 2-16d         |
| 1-inch sheathing to bearing        | 2- 8d         |
| Corner studs and angles            | 16d-30" o/c   |

Timber  
Connections  
and  
Fastenings  
(Cont'd.)

Nails driven parallel to the grain of the wood shall not be allowed for resisting computed tensile stresses.

3. **Spacing and penetration.** Common wire nails shall have penetration into the piece receiving the point as set forth in Table No. 25-G. Nails or spikes, for which the wire gauges or lengths are not specified in Table No. 25-G, shall have a required penetration of not less than  $9\frac{1}{2}$  diameters, and allowable loads may be interpolated.

For wood to wood joints the spacing center to center shall be not less than the required penetration.

Edge and end distances shall be not less than one-half of the required penetration.

Holes for nails, where necessary to prevent splitting, shall be bored of a diameter smaller than that of the nails.

4. **Group I and J occupancies.** The number and size of nails connecting wood members of Groups I and J occupancies shall be not less than the amount set forth in Table No. 25-I. Other connections shall be nailed to provide relative strength.

(g) **Joist Hangers and Framing Anchors.** Connections depending upon joist hangers or framing anchors, ties, and other mechanical fastenings not otherwise covered may be used where approved.

Vertical  
Members or  
Assemblies

Sec. 2507. (a) **Columns or Posts.** All wood columns and posts shall be framed to true end bearings; shall extend down to supports of such design as to hold the column or post securely in position and to protect its base from de-

terioration; and shall be supported in basements by piers projecting at least two inches (2") above the finished floor and separated therefrom by an approved metal barrier, or when pressure-impregnated timber is used, it may be placed directly on concrete or masonry.

**Vertical  
Members or  
Assemblies  
(Cont'd.)**

Untreated wood columns in basements, when built into masonry partitions or walls, shall be exposed on at least two sides.

**(b) Stud Walls and Bearing Partitions. 1. Placing.** Studs in walls and partitions may be placed with their wide faces parallel to the wall or partition, provided the studs are considered as columns and are designed accordingly. Stud walls shall have top and bottom plates except that joists may be supported by a let-in ribbon as provided in Section 2504 (g).

**2. Size.** Except as otherwise provided, exterior stud walls and bearing partitions for buildings of two stories or less shall consist of not less than two-inch by four-inch (2" x 4") studs; for buildings of three stories, the studding shall be not less than three-inch by four-inch (3" x 4") or two-inch by six-inch (2" x 6") to the bottom of the second floor joists, and two-inch by four-inch (2" x 4") for the two upper stories.

**3. Height.** Unless supported laterally by adequate framing, the maximum allowable height shall be ten feet (10') for two-inch by three-inch (2" x 3") stud framing; fourteen feet (14') for two-inch by four-inch (2" x 4") stud framing; sixteen feet (16') for three-inch by four-inch (3" x 4") stud framing; and twenty feet (20') for two-inch by six-inch (2" x 6") stud framing.

**4. Spacing.** Except for one-story detached buildings of Group J occupancy, where twenty-four inch (24") spacing may be used, no studding shall be spaced more than sixteen inches (16") on center unless vertical supporting members in the walls are designed as columns, or such walls may be constructed of not less than four-inch by four-inch (4" x 4") posts spaced not more than five feet four inches (5'4") on center, or of larger members designed as required in this Chapter, or may be of post and beam framing with plank sheathing not less than one and one-half inches (1½") thick.

**5. Corners and bracing.** Angles or corners where stud walls or partitions meet shall be framed solid. All exterior walls and main cross stud partitions shall be effectively and thoroughly braced or sheathed with approved panels adequately nailed along all edges.

**6. Pipes in walls.** Stud partitions containing plumbing, heating, or other pipes shall be so framed and the joists underneath so spaced as to give proper clearance for the piping. Where a partition containing such piping runs parallel to the floor joists, the joists underneath such partitions shall be doubled and spaced to permit the passage of such pipes and shall be bridged. Where plumbing, heating, or other pipes are placed in or partly in a partition, necessitating the cutting of the soles or plates, a metal tie not less

**Vertical  
Members or  
Assemblies  
(Cont'd.)**

than one-eighth inch ( $\frac{1}{8}$ " ) thick and one and one-half inches ( $1\frac{1}{2}$ " ) wide shall be fastened to the plate across and to each side of the opening with not less than four 16d nails.

**7. Separations from chimneys.** For clearance space between chimneys and combustible materials, see Section 3702 (j).

**8. Top plates.** In bearing partitions the top plate shall be doubled and lapped at each intersection with walls or partitions. Joints in the upper and lower members of the top plates shall be staggered not less than four feet (4').

**9. Base plates.** Stud walls resting on masonry or concrete shall have base plates or sills as provided in Section 2805 (a).

**10. Foundation studs.** Foundation studs shall be not less in size than the studding above, and when exceeding four feet (4') in height shall be of the size required for an additional story.

Foundation studs under bearing walls and partitions shall be thoroughly and effectively braced.

**11. Bridging.** All stud partitions or walls over ten feet (10') in height shall have bridging, not less than two inches (2") in thickness and of the same width as the stud, fitted snugly and spiked into the studs at their mid-height, or other means for giving adequate lateral support to the studs. Bridging meeting the requirements of Section 2512 may serve as required fire-stopping.

**12. Headers.** All openings four feet (4') wide or less in bearing walls shall be provided with headers equivalent to double headers not less than two inches (2") thick, placed on edge, securely fastened together, and all openings more than four feet (4') wide shall be trussed or provided with headers or lintels. Such headers or trusses shall have not less than two-inch (2") solid bearing at each end to the floor or bottom plate, unless other approved framing method or joint devices are used.

**(c) Walls Without Studs.** Detached one-story buildings of Group J occupancy may have exterior walls framed without studs when of vertical two-inch (2") or thicker planks, or when having a total floor area of not more than five hundred square feet (500 sq. ft.) may be of vertical one-inch (1") boards and battens.

**(d) Laminated Walls and Partitions.** Walls and partitions may be of laminated construction of not less than four inches (4") nominal thickness, with the structural assembly designed to support all loads.

**(e) Interior Partitions.** Interior partitions shall be constructed, framed, and firestopped as specified for exterior walls, except that interior non-bearing partitions may have a single top plate. In Group I occupancies, non-bearing partitions two-inch by three-inch (2" x 3") studs spaced sixteen inches (16") on center may be used.

Where wood-frame walls and partitions are covered on the interior with plaster, tile, or similar materials and are subject to water splash, the framing shall be protected with 15-pound asphalt-saturated felt.

(f) **Exterior Wall Coverings.** 1. **General.** Exterior wood stud walls shall be covered on the outside with the materials and in the manner specified in this Section. **Vertical Members or Assemblies**

2. **Weatherboarding.** Studs or sheathing shall be covered on the outside face with one layer of building paper when required in Section 1707 (a). **(Cont'd.)**

Weatherboarding shall have an average thickness in place of not less than five-eighths inch ( $\frac{5}{8}$ " ) and a minimum thickness of not less than three-eighths inch ( $\frac{3}{8}$ " ). Horizontal joints in the weatherboarding shall be tongued and grooved or shiplapped joints, or such weatherboarding shall be laid shingle fashion and lapped not less than one-half inch ( $\frac{1}{2}$ " ).

Siding patterns known as rustic, drop siding, or shiplap shall have an average thickness in place of not less than nineteen thirty-seconds inch ( $\frac{19}{32}$ " ) and shall have a minimum thickness of not less than three-eighths inch ( $\frac{3}{8}$ " ). Bevel siding shall have a minimum thickness measured at the butt section of not less than seven-sixteenths inch ( $\frac{7}{16}$ " ) and a tip thickness of not less than three-sixteenths inch ( $\frac{3}{16}$ " ). Siding of lesser dimensions may be used, provided such wall covering is placed over sheathing which conforms to the provisions of Section 2202.

All weatherboarding or siding shall be securely nailed to each stud with not less than one nail, or to solid nominal wood sheathing with not less than one line of nails spaced not more than twenty-four inches (24" ) on center in each piece of the weatherboarding or siding.

Nails shall be so located as to hold the bottom of the weatherboarding or siding secure and thereby to hold tight the top of the piece below. Where such nailing is not possible, two nails to each stud shall be used to hold each piece.

3. **Plywood.** Where plywood is used for covering the exterior of outside walls, it shall be of the exterior type not less than three-eighths inch ( $\frac{3}{8}$ " ) thick. Joints shall occur over framing members not less than two inches (2" ) thick, unless wood or plywood sheathing is used, or joints are lapped horizontally or otherwise made waterproof to the satisfaction of the Building Official.

4. **Wood shingles or shakes.** Wood shingles or shakes may be used for exterior wall covering provided the frame of the structure is covered with building paper as specified in Section 1707 (a). The thickness of the shingles or shakes between wood nailing boards shall be not less than three-eighths inch ( $\frac{3}{8}$ " ).

5. **Weather-resistant metal.** Painted, treated, or non-corrosive metal may be used on stud walls. When sheathing is omitted the installation must be approved by the Building Official. Contact between dissimilar metals shall be broken by approved methods. Galvanized steel sheets formed or flat may be used.

6. **Exterior plastering.** See Chapter 47.

7. **Masonry veneer.** See Chapter 29.

**Sec. 2508. (a) Bearing.** Every beam, girder, and joist shall have sufficient bearing area so that the compression perpendicular to the grain values set forth in Tables No. 25-A, No. 25-C, or No. 25-D are not exceeded. **Horizontal Members or Assemblies**

**Horizontal  
Members or  
Assemblies  
(Cont'd.)**

**EXCEPTIONS:** 1. Two-inch (2") joists when nailed to adjacent studs may be supported on a one-inch (1") let-in ribbon.

2. Approved devices or other manner of support may be used in lieu of bearing.

Wood members bearing on or in contact with masonry or concrete at or below adjacent ground level shall be as specified for mudsills in Section 2805 (a).

(b) **Built-up Members.** 1. **Beams.** Laminated built-up beams with through lamination not less than two inches (2") in nominal thickness may be used in place of solid timbers when the laminations are parallel to applied loads. Laminated beams ten inches (10") or less in depth may be spiked together with not less than 16d spikes at twelve-inch (12") centers, staggered. Unless so spiked, or if the depth of beam is more than ten inches (10"), the laminations shall be connected together with bolts not smaller than one-half inch ( $\frac{1}{2}$ ") diameter spaced not over two feet (2') apart, staggered or equal. Fastenings shall be placed at a maximum of one-fourth the depth of the member from the top and bottom edges.

2. **Other built-up members.** Types of built-up members not mentioned in this Code may be designed and constructed as set forth in U.B.C. Standard No. 25-23.

3. **Trusses.** The design, fabrication, and erection of timber trusses shall conform to the provisions of this Code.

(c) **Joist and Rafter Blocking and Bridging.** Rafters of more than eight-inch (8") depth and joists of more than four-inch (4") depth shall be stabilized against overturning or buckling from superimposed load as follows:

1. At ends and at each support, by solid blocking of not less than two-inch (2") thickness and the full depth of joists, by nailing to studs when supported by ribbon boards, or by approved hangers or fastenings.

2. Between supports as required so that joists will be stabilized every eight feet (8') and rafters every ten feet (10') by solid blocking two inches (2") thick and the full depth of the joist or rafter, or by wood cross bridging of not less than one inch by three inches (1"x 3") or metal cross bridging of equal strength. Where cross bridging is used, the lower ends of such cross bridging shall be driven up and nailed after the floor or subfloor has been nailed.

(d) **Joists under Bearing Partitions.** Joists under and parallel to bearing partitions shall be doubled and well spiked, or may be separated by solid blocking spaced at no more than four-foot (4') intervals.

(e) **Headers.** Header joists over six feet (6') long and tail joists over twelve feet (12') long shall be hung in joist or beam hangers or framing anchors or secured by other devices or methods affording equivalent support. Trimmers

and header joists more than four feet (4') long shall be doubled. Headers shall be not less than twenty inches (20") from face of chimney breast. Trimmers and headers shall be provided with clearance from flues, chimneys, and fireplaces as specified in Sections 3702 (j) and 3713 (a) 5.

**Horizontal  
Members or  
Assemblies  
(Cont'd.)**

(f) **Wood Members Entering Masonry or Concrete.** The ends of wood members entering masonry or concrete walls from opposite sides shall be separated by not less than four inches (4") of solid masonry. Other wood members shall be set back not less than four inches (4") from the exterior face of walls, except on street fronts.

Ends of wood beams or joists entering masonry or concrete walls, unless pressure-impregnated with an approved preservative, shall be provided with a one-half-inch ( $\frac{1}{2}$ ") air space on sides and end.

Ends of wood beams or joists entering masonry or concrete walls shall be beveled so that top edge does not enter more than one inch (1").

(g) **Anchors and Ties.** For anchorage of wood joists or beams to masonry walls see Section 2417 (g).

(h) **Floors.** See Sections 2514 and 2515.

(i) **Roofs.** See Sections 2514 and 2515.

**Sec. 2509.** The vertical dead load of structural masonry or concrete shall not be supported by wood members, other than wood piling, except as herein provided. Wood may be combined structurally with masonry or concrete if provision is made for the different rigidities and other properties of the materials, except as provided in Section 2416 (c).

**Wood with  
Masonry  
or Concrete**

**Sec. 2510.** Stressed skin panels shall be designed in accordance with U.B.C. Standard No. 25-26.

**Stressed  
Skin Panel  
Design**

**Sec. 2511. (a) General.** Wood and plywood diaphragms may be used to resist horizontal forces in horizontal and vertical distributing or resisting elements, provided the deflection in the plane of the diaphragm, as determined by calculations, tests, or analogies drawn therefrom, does not exceed the permissible deflection of attached distributing or resisting elements.

**Wood  
Diaphragms**

Permissible deflection shall be that deflection up to which the diaphragm and any attached distributing or resisting element will maintain its structural integrity under assumed load conditions, i. e., continue to support assumed loads without danger to occupants of the structure.

Connections and anchorages capable of resisting the design forces shall be provided between the diaphragms and the resisting elements. Openings in diaphragms which materially affect their strength shall be fully detailed on the plans, and shall have their edges adequately reinforced to transfer all shearing stresses.

Size and shape of diaphragms shall be limited as set forth in Table No. 25-J.

**TABLE NO. 25-J—MAXIMUM DIAPHRAGM  
DIMENSION RATIOS**

|   | HORIZONTAL<br>DIAPHRAGMS        | VERTICAL<br>DIAPHRAGMS            |
|---|---------------------------------|-----------------------------------|
|   | Maximum<br>Span-Width<br>Ratios | Maximum<br>Height-Width<br>Ratios |
| 1. Diagonal sheathing, conventional                 | 3:1                             | 2:1                               |
| 2. Diagonal sheathing, special                      | 4:1                             | 3½:1                              |
| 3. Plywood, nailed all edges                        | 4:1                             | 3½:1                              |
| 4. Plywood, blocking omitted at intermediate joints | 4:1                             | 2:1                               |

**Wood  
Diaphragms  
(Cont'd.)**

In buildings of wood construction where rotation is provided for, transverse shear resisting elements normal to the longitudinal element shall be provided at spacings not exceeding 1½ times the width for conventional diagonally sheathed diaphragms or two times the width for special diagonally sheathed or plywood diaphragms.

In masonry or concrete buildings wood and plywood diaphragms shall not be considered as transmitting lateral forces by rotation.

**(b) Diagonally Sheathed Diaphragms. 1. Conventional construction.** Such wood diaphragms shall be made up of one-inch (1") nominal sheathing boards laid at an angle of approximately 45 degrees to supports. Sheathing boards shall be directly nailed to each intermediate bearing member with not less than two 8d nails for one-inch by six-inch (1"x6") boards and three 8d nails for boards eight inches (8") or wider, and in addition three 8d nails and four 8d nails shall be used for six-inch (6") and eight-inch (8") boards, respectively, at the diaphragm boundaries. End joints in adjacent boards shall be separated by at least one joist or stud space, and there shall be at least two boards between joints on the same support. Boundary members at edges of diaphragms shall be designed to resist direct tensile or compressive chord stresses and shall be adequately tied together at corners.

Conventional wood diaphragms may be used to resist shears, due to wind or seismic forces, not exceeding 300 pounds per lineal foot of width.

**2. Special construction.** Special diagonally sheathed diaphragms shall conform to conventional construction and, in addition, shall have all elements designed in conformance with the provisions of this Code.

Each chord or portion thereof may be considered as a beam, loaded with a uniform load per foot equal to 50 per cent of the unit shear due to diaphragm action. The load shall be assumed as acting normal to the chord, in the plane of the diaphragm and either toward or away from the dia-



phragm. The span of the chord, or portion thereof, shall be the distance between structural members of the diaphragm such as the joists, studs, and blocking, which serve to transfer the assumed load to the sheathing. **Wood Diaphragms (Cont'd.)**

Special diagonally sheathed diaphragms shall include conventional diaphragms sheathed with two layers of diagonal sheathing at 90 degrees to each other and on the same face of the supporting members.

Special diagonally sheathed diaphragms may be used to resist shears, due to wind or seismic loads, provided such shears do not stress the nails beyond their allowable safe lateral strength and do not exceed 600 pounds per lineal foot of width.

(c) **Plywood Diaphragms.** Horizontal and vertical diaphragms sheathed with plywood may be used to resist horizontal forces not exceeding those set forth in Table No. 25-K, or may be calculated by principles of mechanics without limitation by using values of nail strength and plywood shear values as given elsewhere in this Code. Plywood thickness for horizontal diaphragms shall be not less than that set forth in Tables No. 25-L and No. 25-M for corresponding joist spacing and loads, except that one-fourth inch ( $\frac{1}{4}$ " ) plywood may be used where perpendicular loads permit.

All boundary members shall be proportioned and spliced where necessary to transmit direct stresses. Framing members shall be at least one and five-eighths inches ( $1\frac{5}{8}$ " ) wide. In general, panel edges shall bear on the framing members and butt along their center lines. Nails shall be placed not less than three-eighths inch ( $\frac{3}{8}$ " ) in from the panel edge, not more than twelve inches (12" ) apart along intermediate supports and six inches (6" ) along panel edge-bearings, and shall be firmly driven into the framing members. No unblocked panels less than twelve inches (12" ) wide shall be used.

When blocking is omitted and the panels are arranged so that load is applied perpendicular to the unblocked edges and to the continuous panel joints, shears shall not exceed two-thirds of the values given for six-inch (6" ) nail spacing in Table No. 25-K. For other panel arrangements shears shall not exceed one-half of the tabulated values for six-inch (6" ) nail spacing.

**Sec. 2512.** Fire-stopping shall be provided to cut off all concealed draft openings (both vertical and horizontal), and form an effective barrier between stories, and between a top story and roof space. It shall be used in specific locations, as follows: **Fire Stops**

1. In exterior or interior stud walls, at ceilings and floor levels.
2. In all stud walls and partitions, including furred spaces, so placed that the maximum dimension of any concealed space is not over eight feet (8').
3. Between stair stringers at least once in the middle portion of each run, at top and bottom, and between studs, along and in line with run of stair adjoining stud walls and partitions.

**TABLE NO. 25-K—ALLOWABLE SHEAR FOR WIND OR  
SEISMIC LOADINGS ON BLOCKED DOUGLAS FIR  
PLYWOOD DIAPHRAGMS**  
(Pounds per Foot)

**For Douglas Fir and Southern Pine Framing**  
(For other species adjust values accordingly)

| MINIMUM<br>PLYWOOD*<br>THICKNESS | COM-<br>MON<br>NAIL<br>SIZE | NAIL SPACING ON ALL PLYWOOD PANEL EDGES†            |     |     |  |     |     |
|----------------------------------|-----------------------------|---|-----|-----|--|-----|-----|
|                                  |                             | For Framing Member<br>2½ Inches or More in<br>Width |     |     | For Framing Member<br>Less than 2½ Inches<br>but not Less than 1½<br>Inches in Width |     |     |
|                                  |                             | 6"  | 4"  | 3"  | 6"   | 4"  | 3"  |
| 5/16"***                         | 6d                          | 280   | 420 | 475 | 250  | 375 | 420 |
| 3/8"                             | 8d                          | 400   | 600 | 675 | 360  | 530 | 600 |
| 1/2"                             | 10d                         | 480   | 720 | 820 | 425  | 640 | 730 |

†NOTE: When the force acting along either boundary or any line of continuous panel joints exceeds three-fourths of the tabulated value, nail spacing along such boundary or line shall be reduced by one-third.

\*For Douglas fir plywood grades having inner plies of species other than Douglas fir use next greater thickness or reduce shears one-fourth.

\*\*These values may be used with 3/4" plywood where perpendicular loads permit its use.

**TABLE NO. 25-L—MINIMUM THICKNESSES OF  
PLYWOOD SUBFLOORING**  
(Plywood Continuous over Two or More Spans; and Face  
Grain Perpendicular to Supports)

| PLYWOOD<br>THICKNESS¹ | MAXIMUM SPACING OF JOISTS |           |            |
|-----------------------|---------------------------|-----------|------------|
|                       | Residential<br>40 p.s.f.  | 50 p.s.f. | 100 p.s.f. |
| 1/2" rough            | 16"                       | 16"       | 16"        |
| 5/8"                  | 20"                       | 20"       | 20"        |
| 3/4"                  | 24"                       | 24"       | 24"        |

1. Blocking installed at edges, unless twenty-five thirty-seconds-inch (25/32") wood strip finish floor is used. If wood strips are perpendicular to supports, one-half inch (1/2") can be used on twenty-four-inch (24") span.

**TABLE NO. 25-M—MINIMUM THICKNESSES OF  
PLYWOOD ROOF SHEATHING**  
(Plywood Continuous over Two or More Spans; and Face  
Grain Perpendicular to Supports)

| PLYWOOD<br>THICKNESS | MAXIMUM SPACING OF SUPPORTS, C TO C (Inches) |           |           |
|----------------------|--|-----------|-----------|
|                      | 20 p.s.f.                                    | 30 p.s.f. | 40 p.s.f. |
| 5/16" rough          | 16   | 16        | 16        |
| 3/8" rough           | 24¹  | 24        | 24        |
| 1/2" rough²          | 32¹  | 32        | 30        |
| 5/8" rough²          | 42¹  | 42        | 36        |
| 3/4"³                | 48¹  | 48¹       | 42        |

1. These spans shall not be exceeded under any load condition.  
2. Provide adequate blocking or suitable edge support when span exceeds 28 inches for one-half inch; 32 inches for five-eighths inch; and 36 inches for three-fourths inch.

4. Around top, bottom, sides, and ends of sliding door pockets. **Fire Stops (Cont'd.)**
5. In spaces between chimneys and wood framing, loose incombustible materials shall be placed in incombustible supports, or a metal collar tightly fitted to the chimney and nailed to the wood framing may be used.
6. Any other locations not specifically mentioned above, such as holes for pipes, shafting, behind furring strips and similar places which could afford a passage for flames.

Fire stops when of wood shall be two-inch (2") nominal thickness. If width of opening is such that more than one piece of lumber is necessary, there shall be two thicknesses of one-inch (1") material with joints broken.

**Sec. 2513. (a) Design and Allowable Unit Stresses. 1. Design formulas.** **Glued Construction** Glued laminated and glued built-up structural members shall be designed by the applicable engineering formulas used for sawn members, plywood, and as otherwise provided without exceeding the allowable unit stresses specified in Section 2504 and modified in this Section.

**2. Curvature factor.** For the curved portion of members, the allowable stress in bending shall be modified by multiplication by the following curvature factor:

$$1 - 2000 \left( \frac{t}{R} \right)^2$$

WHERE:

$t$  = thickness of lamination in inches,

$R$  = radius of curvature of a lamination in inches, and  $t/R$  shall not exceed  $1/125$  for softwoods and  $1/100$  for hardwoods. No curvature factor shall be applied to stress in the straight portion of an assembly regardless of curvature elsewhere.

**3. Radial tension or compression.** The radial stress induced by a bending moment in a curved rectangular member shall be limited to the allowable stress,  $S_R$ , when computed by the equation

$$S_R = \frac{3 M}{2R bh}$$

WHERE:

$M$  = bending moment in inch pounds

$R$  = radius of curvature at center line of member in inches.

When  $M$  is in the direction tending to decrease curvature (increase the radius), the stress is in tension and shall be limited to an allowable stress equal to one-third the allowable stress in shear.

When  $M$  is in the direction tending to increase curvature (decrease radius), the stress is in compression and shall be limited to the allowable stress in compression perpendicular to the grain.

**Glued  
Construction  
(Cont'd.)**

(b) **Fastenings.** The methods of design of bolts and connectors and their allowable loads when used with glued laminated lumber, shall be the same as provided for their use with sawn lumber.

(c) **Fabrication of Members.** 1. **General.** Structural glued laminated lumber shall be fabricated in accordance with good practice and as set forth in the applicable U.B.C. Standards No. 25-19, No. 25-20, No. 25-21, or No. 25-22.

All work shall be under the supervision of qualified personnel.

2. **Laminations.** The individual laminations in structural glued laminated lumber shall be not more than two inches (2") in thickness and all such laminations in the stressed portion shall be approximately parallel to the neutral plane of the member.

3. **Lumber grade.** The lumber, at the time of laminating, shall conform to the grade and species specified.

4. **Moisture content.** The maximum moisture content of the wood at the time of gluing shall not exceed 16 per cent and shall be not less than 7 per cent. The range of moisture content of laminations assembled into a single member shall not exceed 5 per cent at the time of gluing.

5. **Surfaces.** Surfaces to be glued shall be free from dust, dirt, and grease. Each lamination shall be smoothly surfaced and be of uniform thickness with a maximum allowable variation of one sixty-fourth inch ( $1/64"$ ) for softwoods and one one-hundredth inch ( $1/100"$ ) for hardwoods. Lumber surfaces shall not be sanded before gluing, except that factory-sanded plywood shall not be prohibited.

6. **Joints.** Joints in structural glued laminated lumber shall mean the contact surfaces between two adjacent pieces of wood glued together. An edge or face joint is parallel to the grain of the wood. An end joint is at right angles to the grain of the wood. A scarf joint is a sloping or bevel joint, where pieces of wood are lapped together.

(d) **Adhesives.** 1. **General.** Adhesives shall cover structural gluing, exclusive of plywood. Adhesives shall provide an adequate bond, shall subject the wood to no deleterious chemical reactions, and shall withstand without deterioration the expected conditions of service.

2. **Quality.** Adhesives shall conform to U.B.C. Standard No. 25-30.

3. **Use.** Interior type adhesive may be used only in interior and protected locations where moisture content of the wood will not exceed 15 per cent.

Exterior type adhesive may be used under any conditions of exposure and shall be used where subjected to high humidity.

4. **Tests.** Where sufficient evidence of the quality of adhesive to be used is not available, the Building Official may require tests to be made as set forth in U.B.C. Standards No. 25-30 and No. 25-18.

**5. Adhesive application.** Gluing practices shall take into consideration the characteristics and limitations of the specific adhesive used, and shall conform to good practices as to preparation of wood surfaces for gluing, control of temperature and moisture content of materials, maintenance of adequate pressures, and compatibility of the adhesive with any other wood treatments employed. Mixing, spreading, storage life, pot life, working life, and assembly-time life shall be in accordance with the recommendations of the manufacturer of the adhesive used.

**Glued  
Construction  
(Cont'd.)**

(e) **Inspection.** 1. **Inspection agencies.** All structural glued laminated lumber shall be inspected during lamination by an approved inspection agency.

2. **Certificate of inspection.** Each structural glued laminated member shall be stamped with an identifying number and shall be accompanied by a certificate of inspection as required in Section 5006 (b).

**Sec. 2514. (a) Heavy Timber Framing.** All wood columns in such structural framing shall be directly superimposed, one above the other (no girders or bolsters between columns), and shall be provided with reinforced concrete, steel or cast-iron caps, pintles or base plates, or be connected by timber splice blocks fastened to columns by connectors or by bolts housed within the contact faces. No wood column shall be less than eight inches (8") nominal in its least dimension.

**Heavy  
Timber  
Construction**

Beams, girders, and joists shall be not less than six inches (6") nominal in least dimension, nor less than forty-eight square inches (48 sq. in.) nominal in cross-sectional area.

Where adjoining ends of girders and beams meet at columns, they shall be closely fitted and cross-tied by approved reinforced concrete, steel or iron post caps or metal straps, or shall be inter-tied with columns by through bolted corbel and splice blocks or side bolsters with load transferred by connectors housed within the contacting faces or by bolts. Approved wall plates, boxes, or hangers shall be provided where wood beams, girders, or trusses rest on masonry or concrete walls.

Framing members of wood roof trusses or arches shall be not less than four inches (4") nominal in least dimension, except that top and bottom chords of truss may be built up of elements of not less than three inches (3") nominal thickness when an automatic fire-extinguishing system is installed in the building, as specified in Chapter 38; or when the space between parallel elements is either solidly filled or is tightly closed for the full length on the underside thereof with a wood cover plate of two-inch (2") nominal thickness.

(b) **Heavy Timber Floors.** Heavy timber constructed floors shall be not less than three inches (3") nominal splined or tongued and grooved plank or may be of laminated slab construction conforming to the provisions of paragraph (d). Structural floors shall be covered with one-inch (1") nominal flooring laid crosswise or diagonally. Top flooring shall

**Heavy  
Timber  
Construction  
(Cont'd.)**

not extend closer than one-half inch ( $\frac{1}{2}$ " ) to walls. Such one-half-inch space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinking movements of the floor. Corbeling of masonry walls under floor planks may be used in place of such molding.

(c) **Heavy Timber Roof Decks.** Heavy timber roof decks shall be of tongued and grooved or splined lumber of not less than two inches (2") nominal thickness or of a double thickness of one-inch (1") nominal thickness boards with tongued and grooved joints, or with staggered joints, or of square-edged lumber of not less than three inches (3") nominal width set on edge and securely spiked together. When supporting roof loads only, wood bolsters inter-tying adjoining girders or connecting roof trusses with columns may be used.

(d) **Laminated Floors or Decks.** A laminated lumber floor or deck built up of wood members set on edge, when meeting the following requirements, may be designed as a solid floor or roof deck of the same thickness, and continuous spans may be designed on the basis of the full cross section using the simple span moment coefficient.

1. Laminations shall be driven up and spiked closely together with a row of nails near each edge at spaced intervals and staggered vertically. Nail spacing in each row shall not exceed eighteen inches (18") for two-by-eight-inch (2"x 8") nominal width and be proportional for other plank widths. Nail length shall be not less than two and one-half times the net thickness of each lamination.

2. A single span deck shall have all laminations full length.

3. A continuous deck of two spans shall have not more than each fourth lamination spliced within quarter points adjoining supports.

4. A continuous deck of more than two spans shall have not more than each third lamination spliced within quarter points adjoining supports.

5. Joints shall be closely butted over supports or staggered across the deck but within the adjoining quarter spans.

6. No lamination shall be spliced more than twice in any span.

(e) **Heavy Timber Roof Anchorage.** In heavy timber construction every roof girder, and every alternate roof beam, shall be anchored to an exterior or interior wall or to an interior column; roof planking where supported by a wall shall be anchored to such wall at intervals not exceeding twenty feet (20'); every monitor and every saw-tooth construction shall be anchored to the main roof construction. Such anchors shall consist of steel or iron bolts or straps of sufficient strength to resist the computed vertical uplift of the roof.

**Wood-Joisted  
Dwelling  
Construction**

Sec. 2515. (a) **General.** In addition to the other provisions of this Chapter, the provisions in Subsections (b) to (f) are applicable to dwelling construction.

**TABLE NO. 25-N—ALLOWABLE SPANS FOR  
FLOOR JOISTS**

**(Based on 1100/ and 40-pound per square foot live load)**

| SIZE<br>(Inches) | SPACING<br>CENTER<br>TO CENTER<br>(Inches) | MAXIMUM ALLOWABLE SPAN<br>(Feet and Inches) |                                       |
|------------------|--|---|---------------------------------------|
|                  |  | Plastered<br>Ceiling<br>Below               | Without<br>Plastered Ceiling<br>Below |
| 2 x 6            | 12   | 10-5  | 11-6                                  |
|                  | 16   | 9-1   | 10-0                                  |
|                  | 24   | 7-8   | 8-2                                   |
| 2 x 8            | 12   | 13-10                                       | 15-2                                  |
|                  | 16   | 12-1  | 13-3                                  |
|                  | 24   | 9-11  | 10-11                                 |
| 2 x 10           | 12   | 17-5  | 19-1                                  |
|                  | 16   | 15-2  | 16-8                                  |
|                  | 24   | 12-6  | 13-9                                  |
| 2 x 12           | 12   | 20-11                                       | 22-11                                 |
|                  | 16   | 18-3  | 20-1                                  |
|                  | 24   | 15-1  | 16-7                                  |
| 2 x 14           | 12   | 24-4  | 26-7                                  |
|                  | 16   | 21-4  | 23-5                                  |
|                  | 24   | 17-8  | 19-5                                  |
| 3 x 6            | 12   | 12-4  | 14-5                                  |
|                  | 16   | 11-3  | 12-7                                  |
|                  | 24   | 9-10  | 10-4                                  |
| 3 x 8            | 12   | 16-4  | 18-11                                 |
|                  | 16   | 14-11                                       | 16-7                                  |
|                  | 24   | 13-1  | 13-9                                  |
| 3 x 10           | 12   | 20-6  | 23-7                                  |
|                  | 16   | 18-10                                       | 20-10                                 |
|                  | 24   | 16-5  | 17-3                                  |
| 3 x 12           | 12   | 24-6  | 28-2                                  |
|                  | 16   | 22-7  | 24-11                                 |
|                  | 24   | 20-0  | 20-9                                  |
| 3 x 14           | 12   | 28-7  | 30-6                                  |
|                  | 16   | 26-4  | 28-3                                  |
|                  | 24   | 23-1  | 24-2                                  |

(b) **Floor Joists.** Where the floor joists are not designed as specified in this Chapter, Table No. 25-N sets forth the maximum allowable spans for floor joists of a grade not less than 1100/ or No. 2 Douglas fir or Southern pine or comparable grades in other species, surfaced four sides to the sizes as set forth in U.B.C. Standard No. 25-1, and based on a live load of 40 pounds per square foot uniformly distributed.

Joists of other grades, other woods, and other sizes may be

**Wood-Joisted  
Dwelling  
Construction  
(Cont'd.)**

**TABLE NO. 25-O—ALLOWABLE SPANS FOR CEILING JOISTS AND ROOF RAFTERS****(Based on 1100/ and 20-pound per square foot live load on roofs and 10-pound per square foot on ceiling joists)**

| SIZE<br>(Inches) | SPACING<br>CENTER<br>TO CENTER<br>(Inches) | MAXIMUM ALLOWABLE SPAN<br>(Feet and Inches) |                                  |                                       |  |
|------------------|--|---|----------------------------------|---------------------------------------|--|
|                  |  | Ceiling<br>Joists                           | Rafters                          |                                       |  |
|                  |  |   | Slope of<br>Less than<br>4 in 12 | Slope of<br>4 in 12<br>to<br>12 in 12 | Slope of<br>12 in 12<br>and<br>Greater |
| 2 x 4            | 12   | 11-0  | 9-11                             | 11-0                                  | 11-10                                  |
|                  | 16   | 10-1  | 8-8                              | 9-7                                   | 10-5                                   |
|                  | 24   | 8-11  | 7-1                              | 7-11                                  | 8-7                                    |
|                  | 32   | 8-1   | 6-1                              | 6-10                                  | 7-5                                    |
| 2 x 6            | 12   | 16-7  | 15-1                             | 16-9                                  | 18-3                                   |
|                  | 16   | 15-4  | 13-3                             | 14-8                                  | 16-0                                   |
|                  | 24   | 13-8  | 10-11                            | 12-2                                  | 13-2                                   |
|                  | 32   | 12-2  | 9-5                              | 10-8                                  | 11-7                                   |
| 2 x 8            | 12   | 21-7  | 19-10                            | 21-10                                 | 23-9                                   |
|                  | 16   | 20-1  | 17-5                             | 19-3                                  | 22-0                                   |
|                  | 24   | 17-11                                       | 14-6                             | 16-0                                  | 17-4                                   |
|                  | 32   | 16-6  | 12-6                             | 14-0                                  | 15-2                                   |
| 2 x 10           | 12   | 26-9  | 24-9                             | 27-2                                  | 29-8                                   |
|                  | 16   | 25-0  | 21-10                            | 24-0                                  | 26-2                                   |
|                  | 24   | 22-5  | 18-2                             | 20-1                                  | 22-0                                   |
|                  | 32   | 20-8  | 15-9                             | 17-6                                  | 19-2                                   |

**Wood-Joisted  
Dwelling  
Construction  
(Cont'd.)**

used, in which case they shall not be stressed to exceed the maximum allowable unit stress as specified in this Chapter.

(c) **Girders.** Girders supporting first floor joists in dwellings shall be not less than four inches by four inches (4" x 4") for spans of five feet (5') or less, or not less than four inches by six inches (4" x 6") (placed on edge) for spans not more than seven feet (7').

(d) **Rafters and Ceiling Joists.** Where the rafters and ceiling joists are not designed as specified in this Chapter, Table No. 25-O sets forth the maximum allowable spans for ceiling joists and roof rafters of a grade not less than 1100/ or No. 2 Douglas fir or Southern pine or comparable grades in other species, surfaced four sides to the sizes as set forth in U.B.C. Standard No. 25-1 and based on the live loads specified in Section 2305.

Joists or rafters of other grades, other woods, and other sizes may be used, in which case they shall not be stressed to exceed the maximum allowable unit stress as specified in this Chapter.

The allowable span of roof rafters shall be measured along the rafter from plate to ridge, except that where rafters are connected to ceiling joists and a complete truss is formed, the spans shall be considered as the distance between intersecting points of trussing.

Roof framing and trussing shall be thoroughly and effectively angle braced. Roof joists when supported on a ribbon board shall be well nailed to the stud.



(e) **Plank-and-Beam Construction.** Floor and roof systems of plank-and-beam construction may be used for dwelling construction as set forth in U.B.C. Standard No. 25-28.

**Wood-Joisted  
Dwelling  
Construction  
(Cont'd.)**

(f) **Plywood Subflooring.** Where used as structural subflooring, plywood shall be of the minimum thicknesses set forth in Table No. 25-L.

(g) **Plywood Roof Sheathing.** Where used as structural roof sheathing, plywood shall be of the minimum thicknesses set forth in Table No. 25-M.

**Sec. 2516. (a) Foundation Ventilation.** The space under the floors of buildings (without basements or cellars) shall be ventilated through foundation walls, providing cross ventilation where practicable, by openings for a net area of not less than two square feet (2 sq. ft.) for each 100 linear feet of exterior wall plus one-third square foot ( $\frac{1}{3}$  sq. ft.) for each one hundred square feet (100 sq. ft.) of crawl space, and such openings shall be covered with corrosion-resistant wire mesh with openings in such mesh not greater than one-half inch ( $\frac{1}{2}$ " ) nor less than one-fourth inch ( $\frac{1}{4}$ " ) in any dimension.

**Foundation  
Ventilation,  
Durability,  
and Termite  
Protection**

Minimum clearance between bottom of floor joists or bottom of floors without joists and the ground beneath shall be eighteen inches (18"). Minimum clearance under girders shall be twelve inches (12").

(b) **Durability.** Where not otherwise prohibited by other provisions of this Code, no wood, other than Foundation Grade redwood, Foundation Grade cedar, all heartwood cypress, or any species of wood, pressure-treated with an approved preservative, all marked or branded by an approved agency, shall be nearer than six inches (6") to any earth unless separated by concrete at least three inches (3") thick, except that untreated wood may be used where entirely below ground-water level or continuously submerged in fresh water, and untreated wood may be used in fences and similar well-ventilated and accessible non-load-bearing structures where not actually in direct contact with earth.

(c) **Termite Protection.** For additional termite and fungus precautions, see Appendix.

## CHAPTER 26—CONCRETE

**Quality**

**Sec. 2601.** The quality of the materials used in concrete and the quality of concrete shall conform to the physical and chemical properties as specified in Sections 2604, 2605, and 2606, and to the following standards:

| MATERIALS  | U.B.C.<br>DESIGNATION |
|--|-----------------------|
| <b>Portland Cement</b> .....                           | <b>26-1</b>           |
| <b>Aggregates</b>                                      |                       |
| Concrete .....   | 26-2                  |
| Lightweight, for Structural Concrete .....             | 26-3                  |
| <b>Metal Reinforcement</b>                             |                       |
| Billet-Steel Bars .....                                | 26-4                  |
| Rail-Steel Bars .....                                  | 26-5                  |
| Cold-Drawn Steel Wire .....                            | 26-6                  |
| Axle-Steel Bars .....                                  | 26-7                  |
| Deformed Steel Bars .....                              | 26-8                  |
| <b>Molded Concrete Cylinders</b>                       |                       |
| Test for Compressive Strength .....                    | 26-9                  |
| <b>Concrete Compression and Flexure Test Specimens</b> |                       |
| Making and Curing—in the Laboratory .....              | 26-10                 |
| Making and Curing—in the Field .....                   | 26-11                 |
| <b>Ready-Mixed Concrete</b> .....                      | 26-12                 |
| <b>Slabs</b>   |                       |
| Two-Way .....  | 26-13                 |
| Flat .....   | 26-14                 |

**Design**

**Sec. 2602.** The design of reinforced concrete shall conform to the rules and principles specified in this Chapter.

**Definitions**

**Sec. 2603.** The following definitions give the meaning of certain terms as used in this Chapter:

**AGGREGATE**, inert material which is mixed with portland cement and water to produce concrete.

**COLUMN**, an upright compression member the length of which exceeds three times its least lateral dimension.

**CONCRETE**, a mixture of portland cement, fine aggregate, coarse aggregate, and water.

**DEFORMED BAR**, a reinforcing bar conforming to U.B.C. Standard No. 26-8. Bars not conforming to these specifications shall be classed as plain bars. Except as specified in Section 2615, wire mesh with welded intersections not farther apart than six inches (6") in the direction of the principal reinforcement and with cross wires not smaller than No. 10 W. & M. gauge may be rated as a deformed bar.

**EFFECTIVE AREA OF CONCRETE**, the area of a section which lies between the centroid of the tensile reinforcement and the compression face of a flexural member.

**EFFECTIVE AREA OF REINFORCEMENT**, the area obtained by multiplying the right cross-sectional area of the metal reinforcement by the cosine of the angle between its

direction and that for which the effectiveness of the reinforcement is to be determined.

**Definitions  
(Cont'd.)**

**LAITANCE**, extremely fine material of little or no hardness which may collect on the surface of freshly deposited concrete or mortar, resulting from the use of excess mixing water and usually recognized by its relatively light color.

**MORTAR**, a mixture of portland cement, fine aggregate, and water.

**NEGATIVE REINFORCEMENT**, reinforcement so placed as to take tensile stress due to negative bending moment.

**PEDESTAL**, an upright compression member whose height does not exceed three times its least lateral dimension.

**PLAIN CONCRETE**, concrete without metal reinforcement, or reinforced only for shrinkage or temperature changes.

**PNEUMATICALLY PLACED CONCRETE**, a mixture of fine aggregate and cement pneumatically applied by suitable mechanism, and to which water is added immediately prior to discharge from the applicator. It shall be considered as concrete for particulars of design as specified in this Chapter.

**PORTLAND CEMENT**, the product obtained by finely pulverizing clinker consisting essentially of hydraulic calcium silicates, to which no additions have been made subsequent to calcination other than water or untreated calcium sulfate, except that additions not to exceed one per cent of other materials may be interground with the clinker at the option of the manufacturer, provided such materials in the amounts indicated have been shown to be not harmful by tests.

**POSITIVE REINFORCEMENT**, reinforcement so placed as to take tensile stress due to positive bending moment.

**RATIO OF REINFORCEMENT**, the ratio of the effective area of the reinforcement cut by a section of a member to the effective area of the concrete at that section.

**REINFORCED CONCRETE**, concrete in which metal other than that provided for shrinkage or temperature changes is embedded in such a manner that the two materials act together in resisting forces.

**SURFACE WATER**, the water carried by the aggregate except that held by absorption within the aggregate particles themselves.

**Sec. 2604. (a) Portland Cement.** Portland cement shall conform to U.B.C. Standard No. 26-1.

**Materials**

**(b) Concrete Aggregates.** Concrete aggregates, except lightweight aggregates, shall conform to U.B.C. Standard No. 26-2, including the methods of sampling and testing.

Lightweight aggregates for concrete shall conform to U.B.C. Standard No. 26-3, including the methods of sampling and testing.

**Materials  
(Cont'd.)**

Aggregates that do not meet the above specifications but that have been shown by test or actual service to produce concrete of the required strength, durability, watertightness, and wearing qualities, may be used under the provisions of Section 2606, Method 2, where authorized by the Building Official.

The maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between forms of the member for which the concrete is to be used nor larger than three-quarters of the minimum clear spacing between reinforcing bars.

(c) **Water.** Water used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other harmful substances.

(d) **Metal Reinforcement.** Metal reinforcement shall conform to the requirements set forth in U.B.C. Standards No. 26-4, No. 26-5, No. 26-6, or No. 26-7. Deformations on deformed bars shall conform to the requirements set forth in U.B.C. Standard No. 26-8.

All reinforcement bars lacking grade identification marks shall on delivery be accompanied by a manufacturer's guarantee of grade which will identify variations.

(e) **Storage.** Storage of cement and aggregates shall be in a manner to prevent deterioration or the intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

**Tests**

**Sec. 2605.** On concrete work the Building Official shall have the right to require the owner or his agent to make tests of the concrete and other materials from time to time to determine whether the materials and methods in use are such as to produce concrete or reinforced concrete of the quality specified and used in the design of the building or structure. The tests shall be made, when ordered by the Building Official, by the owner or his authorized representative and no responsibility for the expense of these tests shall attach to the Building Department. All such tests shall be made by an approved agency, and copies of the results shall be kept on file in the office of the Building Official for a period of not less than two years after the acceptance of the structure. Specimens for concrete cylinder tests shall be taken at the place where the concrete is being deposited and shall be taken and cured in accordance with the requirements set forth in U.B.C. Standard No. 26-11 and tested in accordance with the requirements set forth in U.B.C. Standard No. 26-9. Test cylinders of pneumatically placed concrete shall be made in a manner that will permit the blast of air to compact firmly the materials and provide proper escape-ment of the air to eliminate possible back pressure, and such cylinders shall be cured and tested as specified above.

The Building Official shall have the right to order the test under load of any portion of a completed structure, when the conditions have been such as to leave reasonable doubt as

to the adequacy of the structure to serve the purpose for **Tests**  
which it is intended. **(Cont'd.)**

When a load test is required, the member or portion of the structure under consideration shall be subject to a superimposed load equal to one and one-half times the live load plus one-half of the dead load. This load shall be left in position for a period of 24 hours before removal. If, during the test, or upon removal of the load, the member or portion of the structure shows evident failure, such changes or modifications as are necessary to make the structure adequate for the rated capacity shall be made; or, where lawful, a lower rating shall be established. The structure shall be considered to have passed the test if the maximum deflection at the end of the 24-hour period does not exceed the value of

$D$  as given by Formula (1):

$$D = \frac{.001 L^2}{12t} \dots \dots \dots (1)$$

WHERE

$L$  is the span,  $t$  is the total depth of the slab or beam and

$D$  is the maximum deflection—all expressed in the same units.

If the deflection exceeds the value of  $D$  as given in Formula (1), the construction shall be considered to have passed the test if within 24 hours after the removal of the load the slabs or beams show a recovery of at least 75 per cent of the observed deflection.

Sec. 2606. For the design of concrete structures, the value of  $f'_c$  used for determining the working stresses are specified in Section 2613 shall be based on the specified minimum ultimate 28-day compressive strength of the concrete, or on the specified minimum ultimate compressive strength at the earlier age at which the concrete may be expected to receive its full load. All plans submitted for approval or used on the job shall clearly show the assumed strength of concrete at a specified age for which all parts of the structure were designed.

**Quality of  
Concrete**

Concrete exposed to the action of freezing weather shall have a water content not greater than six gallons per sack of cement.

**TABLE NO. 26-A—ASSUMED STRENGTH OF  
CONCRETE MIXTURES**

| WATER CONTENT U. S.<br>GALLONS PER 94-LB.<br>SACK OF CEMENT | ASSUMED COMPRESSIVE<br>STRENGTH AT 28 DAYS |
|---|--|
| U. S. Gallons   | Pounds Per Square Inch                     |
| 7½  | 2000                                       |
| 6¾  | 2500                                       |
| 6   | 3000                                       |
| 5   | 3750                                       |

**Quality of  
Concrete  
(Cont'd.)**

The determination of the proportions of cement, aggregate, and water to attain the required strengths shall be made by one of the following methods:

**Method 1—Concrete Made from Average Materials.** When no preliminary tests of the materials to be used are made, the water content per sack of cement shall not exceed the values set forth in Table No. 26-A. Method 2 shall be employed when artificial aggregates or admixtures are used.

**Method 2—Controlled Concrete.** Water contents other than those set forth in Table No. 26-A may be used provided that the strength-quality of the materials proposed for use in the structure shall be established by tests which shall be made in advance of the beginning of operations, using the consistencies suitable for the work and in accordance with U.B.C. Standards No. 26-10 and No. 26-9. A curve representing the relation between the water-content and the average 28-day compressive strength, or earlier strength at which the concrete is to receive its full working load, shall be established for a range of values including all the compressive strengths called for on the plans. The curve shall be established by at least three points, each point representing average values from at least four test specimens. The water-content used in the concrete for the structure, as determined from the curve, shall correspond to a strength which is 15 per cent greater than that called for on the plans. No substitutions shall be made in the materials used on the work without additional tests in accordance herewith to show that the quality of the concrete is satisfactory.

**Proportions  
and  
Consistency**

**Sec. 2607.** The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface. The combined aggregates shall be of such composition of sizes that when separated on the No. 4 standard sieve, the weight passing the sieve (fine aggregate) shall be not less than 30 per cent nor greater than 50 per cent of the total unless otherwise required by the Building Official, except that these proportions do not necessarily apply to light-weight aggregates.

Measurement of materials for ready-mixed concrete shall conform to U.B.C. Standard No. 26-12.

Admixtures of lime or finely pulverized inert materials may be added but not in excess of six per cent by volume of the cement used.

**Control of  
Proportions**

**Sec. 2608.** The methods of measuring concrete materials shall be such that the proportions of all materials can be accurately controlled during the progress of the work and easily checked at any time by the Building Official or his authorized representative. A tolerance of one-fourth gallon of water per sack of cement in any batch of concrete will be

allowed, provided that the average for any 10 consecutive batches does not show a water content greater than that set forth in Table No. 26-A, and on plans as specified in Section 2608. **Control of Proportions (Cont'd.)**

The method of delivering the aggregates to the work and of storing and handling shall be such that the moisture content of the aggregates as they come to the mixer shall not be subject to frequent or unnecessary changes.

**Sec. 2609. (a) Mixing.** The concrete shall be mixed until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. In machine mixing, only batch mixers shall be used. Each batch shall be mixed not less than one minute after all the materials are in the mixer and must be discharged completely before the mixer is recharged. Machine mixers shall have a peripheral speed of approximately two hundred feet (200') per minute. **Mixing and Placing Concrete**

Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in U.B.C. Standard No. 26-12.

**(b) Cleaning Forms and Equipment.** Before concrete is placed all equipment for mixing and transporting the concrete shall be cleaned, all debris shall be removed from the spaces to be occupied by the concrete, forms shall be thoroughly wetted (except in freezing weather) or oiled, and masonry that will be in contact with concrete shall be well drenched (except in freezing weather). Reinforcement shall be thoroughly cleaned and secured in position. Concrete shall not be placed until the forms and reinforcement have been inspected and approved by the Building Official.

**(c) Removal of Water from Excavations.** Water shall be removed from excavations before concrete is deposited, unless otherwise directed by the Building Official. Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete. Water vent pipes and drains shall be filled by grouting or otherwise, after the concrete has hardened thoroughly.

**(d) Transporting Concrete.** Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. It shall be deposited as nearly as practicable in its final position to avoid rehandling or flowing. Under no circumstances shall concrete that has attained its initial set be used.

Equipment for chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials.

**(e) Placing.** Concrete shall be thoroughly compacted with suitable tools. When necessary, openings shall be provided in the forms to permit the placing of concrete in such a manner

**Mixing and  
Placing  
Concrete  
(Cont'd.)**

as to avoid accumulations of hardened concrete on the forms or reinforcing bars. The concrete shall be thoroughly worked around the reinforcement.

(f) **Curing.** Exposed surfaces of concrete shall be kept moist, for a period of at least seven days after being deposited for ordinary cement, and three days for high-early-strength cement.

(g) **Depositing in Cold Weather.** Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near-freezing weather. No frozen materials or materials containing ice shall be used.

All concrete materials and all reinforcement, forms, fillers, and ground with which the concrete is to come in contact shall be free from frost. Wherever the temperature of the surrounding air is below 40 degrees Fahrenheit, all concrete when placed in the forms shall have a temperature of between 60 and 90 degrees Fahrenheit and shall be maintained at a temperature of not less than 50 degrees Fahrenheit for at least 72 hours for normal concrete or 24 hours for high-early-strength concrete, or for as much more time as is necessary to insure proper rate of curing of the concrete. The housing, covering, or other protection used in connection with curing shall remain in place and intact for at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Manure, when used for protection, shall not be applied directly to concrete.

(h) **Bonding Fresh and Hardened Concrete.** Before new concrete is deposited on or against concrete which has set, the forms shall be retightened, the surface of the set concrete shall be roughened, cleaned of foreign matter and laitance, and thoroughly wetted but not saturated. The clean and wetted surfaces of the hardened concrete, including vertical and inclined surfaces, shall be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its set. For walls and columns the grout may be omitted on the horizontal surfaces, but a layer of mortar having the composition of the mortar in the concrete shall be placed before resuming concreting.

**Forms and  
Details of  
Construction**

**Sec. 2610. (a) Design of Forms.** Forms shall conform to the shape, lines, and dimensions of the member as called for on the plans and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain position and shape. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

Temporary openings shall be provided at the base of column and wall forms, and at other points where necessary, to facilitate cleaning and inspection.

(b) **Removal of Forms.** Forms shall not be disturbed until the concrete has hardened sufficiently to permit their re-



removal with safety. Shoring shall not be removed until the member has acquired sufficient strength to support safely its own weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to support both the member and construction loads in a manner that will protect the member from damage.

The Building Official may require forms to remain in place for a specified time.

(c) **Cleaning and Bending Reinforcement.** Metal reinforcement, at the time concrete is placed, shall be free from rust, scale, or other coatings that will destroy or reduce the bond. Bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for other bars, except hooks, shall be made around a pin having a diameter not less than six times the minimum thickness of the bar, except that for bars larger than one inch (1"), the pin shall be not less than eight times the minimum thickness of the bar. All bars shall be bent cold.

(d) **Placing Reinforcement.** Metal reinforcement shall be accurately placed and secured and shall be supported by chairs, spacers, or hangers. The minimum clear distance between parallel bars, except in columns, shall be equal to the nominal diameter of the bars. The minimum clear distance between bars and forms shall be the diameter of round bars and one and one-half times the side dimension of square bars. The clear distance between bars shall be not less than one inch (1") or less than one and one-third times the maximum size of the coarse aggregate. Bars shall be embedded a distance from any face of any member not less than the minimum distance as specified in Section 4303.

When wire or other reinforcement not exceeding one-fourth inch ( $\frac{1}{4}$ ") in diameter is used as reinforcement for slabs not exceeding ten feet (10') in span, the reinforcement may be curved from a point near the top of the slab over the support to a point near the bottom of the slab at mid-span, provided such reinforcement is either continuous over, or securely anchored to the support.

(e) **Splices and Offsets in Reinforcement.** In slabs, beams, and girders, splices of reinforcement shall not be made at points of maximum stress without the approval of the Building Official. Splices, where permitted, shall provide sufficient lap to transfer the stress between bars by bond and shear. In such splices the bars shall be in contact and wired together and the minimum distance specified in Subsection (d) of this Section shall be maintained between bars or between wired splices and adjacent bars or splices.

Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion shall be not more than one in six, and in the case of tied columns the ties shall be spaced not over three inches (3") on center for a distance of one foot (1') below the actual point of offset.

**Forms and  
Details of  
Construction  
(Cont'd.)**

**Forms and  
Details of  
Construction  
(Cont'd.)**

(f) **Protective Covering of Concrete.** At the underside of footings metal reinforcement shall have a minimum covering of three inches (3") of concrete.

In fire-resistive construction, metal reinforcement shall be protected as specified in Section 4303.

Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion.

(g) **Construction Joints.** Joints not indicated on the plans shall be so made and located as least to impair the strength of the completed structure. Where a joint is to be made, any excess water and laitance shall be removed from the surface after concrete is deposited. Before depositing of concrete is resumed the hardened surface shall be treated as specified in Section 2609 (h).

At least two hours must elapse after concrete is deposited in the columns or walls before depositing in beams, girders, or slabs supported thereon. Haunches and column capitals shall be considered as part of, and to act continuous with, the floor.

Construction joints in floors shall be located near the middle of the spans of slabs, beams, or girders, unless a beam intersects a girder at this point, in which case the joints in the girders shall be offset a distance equal to twice the width of the beam. In this last case, provision shall be made for shear by use of inclined reinforcement.

(h) **Embedment of Pipes.** Pipes which will contain liquid, gas, or vapor at other than room temperature shall not be embedded in concrete necessary for structural stability or fire protection. Drain pipes and pipes whose contents will be under pressure greater than atmospheric pressure by more than one pound per square inch shall not be embedded in structural concrete except in passing through from one side to the other of a floor, wall, or beam. Electric conduits and other pipes whose embedment is allowed shall not, with their fittings, displace that concrete of a column on which stress is calculated or which is required for fire protection, to greater extent than four per cent of the area of the cross section. Sleeves or other pipes passing through floors, walls, or beams shall not be of such size or in such location as unduly to impair the strength of the construction; such sleeves or pipes may be considered as replacing structurally the displaced concrete, provided they are not exposed to rusting or other deterioration, are of uncoated iron or steel not thinner than standard wrought-iron pipe, have a nominal inside diameter not over two inches (2"), and are spaced not less than three diameters on center. Embedded pipes or conduits other than those merely passing through shall be not larger in outside diameter than one-third the thickness of the slab, wall, or beam in which they are embedded; shall not be spaced closer than three diameters on center, nor so located as unduly to impair the strength of the construction. Circular uncoated or galvanized electric conduit of iron or steel may be considered as replacing the displaced concrete.

No chase, sleeve, or pipe shall intercept a structural member unless such member is specifically designed therefor.

**Sec. 2611.** The design of reinforced concrete members shall be made with reference to working stresses and safe loads. The accepted theory of flexure as applied to reinforced concrete shall be applied to all members resisting bending. The following assumptions shall be made:

#### Assumptions for Design

- (1) The steel takes all the tensile stress.
- (2) In determining the ratio  $n$  for design purposes, the modulus of elasticity for the concrete shall be taken as 1000/., and that for steel as 30,000,000 pounds per square inch.

**Sec. 2612.** The symbols and notations used in these regulations are defined as follows:

#### Symbols and Notations

- $\alpha$  = Angle between inclined web bars and axis of beam.
- $A_v$  = Total area of web reinforcement in tension within a distance of  $s$ , or the total area of all bars bent up in any one plane.
- $b$  = Width of rectangular section or width of flange of T- or I-sections.
- $b'$  = Width of web of I- or T-sections.
- $C$  = Ratio of permissible concrete fiber stress in axially loaded column to permissible fiber stress in flexure.
- $d$  = Depth from compression face of beam or slab to centroid of longitudinal tensile reinforcement.
- $e$  = Eccentricity of the resultant load on a column, measured from the gravity axis.
- $E_c$  = Modulus of elasticity of concrete in compression.
- $E_s$  = Modulus of elasticity of steel in tension or compression (30,000,000 lbs. per sq. in.).
- $f_c$  = Compressive unit stress in extreme fiber of concrete in flexure.
- $f'_c$  = Ultimate compressive strength of concrete *usually* at age of 28 days. (See Section 2606.)
- $f_r$  = Tensile unit stress in web reinforcement.
- $I$  = Moment of inertia of a section about the neutral axis for bending.
- $j$  = Ratio of distance between centroid of compression and centroid of tension to the depth ( $d$ ).
- $n$  = Ratio of modulus of elasticity of steel to that of concrete =  $\frac{E_s}{E_c}$
- $R$  = Least radius of gyration of a section.
- $\Sigma_o$  = Sum of perimeters of bars in one set.
- $s$  = Spacing of stirrups or of bent bars in a direction parallel to that of the main reinforcement.
- $t_1$  = Thickness of flat slab without drop panels, or the thickness of flat slab through the drop panels where such are used.
- $t_2$  = Thickness of flat slab (with drop panels) at points outside the drop panel.
- $u$  = Bond stress per unit of surface area of bar.
- $v$  = Shearing unit stress.

**TABLE NO. 28-B—ALLOWABLE UNIT STRESSES IN CONCRETE**

| ALLOWABLE UNIT STRESSES  |  |                               |   |                                  |                                  |                                 |
|--|--|-------------------------------|---|----------------------------------|----------------------------------|---------------------------------|
| DESCRIPTION  | For any<br>strength of<br>concrete as<br>fixed by test<br>in accord-<br>ance with<br>Sec. 2606<br>$\bar{c} = 30,000$<br>$f'_c$ | Maxi-<br>mum<br>value,<br>psi | When strength of concrete is fixed by the<br>water content in accordance with Sec. 2606 |                                  |                                  |                                 |
|  |  |                               | $f'_c = 2000$<br>psi<br>$n = 15$  | $f'_c = 2500$<br>psi<br>$n = 12$ | $f'_c = 3000$<br>psi<br>$n = 10$ | $f'_c = 3750$<br>psi<br>$n = 8$ |
| Flexure: $f_c$   |  |                               | 900   | 1125                             | 1350                             | 1688                            |
| Extreme fiber stress in compression                                      | 0.45%  |                               |   |                                  |                                  |                                 |
| Extreme fiber stress in tension in plain<br>concrete footings            | 0.03%  |                               | 60  | 75                               | 90                               | 113                             |
| Shear: $v$ (as a measure of diagonal tension)                            | 0.03%  |                               | 60  | 75                               | 90                               | 113                             |
| Beams with no web reinforcement  |  |                               |   |                                  |                                  |                                 |
| Beams with properly designed web<br>reinforcement                        | 0.12%  |                               | 240   | 300                              | 360                              | 450                             |
| *Flat slabs at distance $d$ from edge of<br>column capital or drop panel | 0.03%  |                               | 60  | 75                               | 90                               | 113                             |
| **Footings   | 0.03%  | 75                            | 60  | 75                               | 75                               | 75                              |
| Reinforced concrete shear walls  | 0.05%  |                               | 100   | 125                              | 150                              | 187                             |
| Bond: $u$  |  |                               |   |                                  |                                  |                                 |
| Deformed bars  |  |                               |   |                                  |                                  |                                 |
| Top bars   | 0.07%  | 245                           | 140   | 175                              | 210                              | 245                             |
| In 2-way footings (except top bars)                                      | 0.08%  | 280                           | 160   | 200                              | 240                              | 280                             |
| All others   | 0.10%  | 350                           | 200   | 250                              | 300                              | 350                             |
| Plain bars (must be hooked)  |  |                               |   |                                  |                                  |                                 |
| Top bars   | 0.03%  | 105                           | 60  | 75                               | 90                               | 105                             |
| In 2-way footings (except top bars)                                      | 0.036%   | 126                           | 72  | 90                               | 108                              | 126                             |
| All others   | 0.045%   | 158                           | 90  | 113                              | 135                              | 158                             |
| Bearing: $f_c$   |  |                               |   |                                  |                                  |                                 |
| On full area   | 0.25%  |                               | 500   | 625                              | 750                              | 938                             |
| On one-third area or less*   | 0.375%   |                               | 750   | 938                              | 1125                             | 1405                            |
| Pedestals [See Sec. 2621(e)]   |  |                               |   |                                  |                                  |                                 |

**\*See Sec. 2617(g). \*\*See Secs. 2617(h), 2618(e), and 2624(e).**

See Sec. 2011(A). See Secs. 2011(A), 2013(C), and 2021(C).

†The allowable bearing stress on an area greater than one-third but less than the full area shall be interpolated between the values given.

|   |  |
|---|--|
| $v_s$ = Unit shearing stress permitted on the concrete of the web.                    | <b>Symbols and Notations (Cont'd.)</b> |
| $V$ = Total shear.  |  |
| $V'$ = Excess of the total shear over that permitted on the concrete.                 |  |
| $w$ = Uniformly distributed load per unit of length of beam or per unit area of slab. |  |

**Sec. 2613.** The unit stresses in pounds per square inch on concrete to be used in the design shall not exceed the values set forth in Table No. 26-B where  $f'_c$  equals the minimum ultimate compressive strength at 28 days, or at the earlier age at which the concrete may be expected to receive its full load.

The following unit stresses in reinforcing steel shall not be exceeded:

**In Tension:**

|   |               |
|---|---------------|
| Intermediate- and hard-grade billet or axle steel, rail steel and cold-drawn wire....   | 20,000 p.s.i. |
| Structural grade bars and structural steel shapes .....   | 18,000 p.s.i. |
| For one-way slabs not exceeding 12 feet in span, steel reinforcement not exceeding $\frac{3}{8}$ inch in diameter, 50 per cent of the minimum yield point specified in the U.B.C. Standards for the particular kind and grade of steel used, but in no case to exceed ..... | 30,000 p.s.i. |

**In Compression:**

|   |               |
|---|---------------|
| Structural steel section in composite columns ..... | 16,000 p.s.i. |
| Cast-iron section in composite columns.....         | 10,000 p.s.i. |

**Sec. 2614.** All members shall be designed to resist at all sections the maximum bending moments and shears produced by dead load, live load, and other loads, as determined by the principle of continuity. In the case of approximately equal spans with loads uniformly distributed, where the intensity of live load does not exceed three times the intensity of dead load, this is satisfied essentially by the following values:

Negative moment at face of first interior support:

For beams and girders and for slabs exceeding ten feet (10'):

|   |                      |
|---|----------------------|
| Two spans                               | $\frac{1}{8} wl'^2$  |
| More than two spans                     | $\frac{1}{10} wl'^2$ |
| For slabs not exceeding 10 feet in span |                      |
| Two spans                               | $\frac{1}{10} wl'^2$ |
| More than two spans                     | $\frac{1}{12} wl'^2$ |

**Allowable Unit Stresses in Reinforcement**

**Flexural Computations**

**Flexural  
Computations  
(Cont'd.)**

Negative moment at face of other interior supports

$$\frac{1}{12} w l'^2$$

Positive moment at center of span

$$\frac{1}{10} w l'^2$$

$$\frac{1}{12} w l'^2$$

$$\text{Shear in end members at first interior support } 1.20 \frac{w l'}{2}$$

$$\text{Shear at other supports } \frac{w l'}{2}$$

For the purpose of applying this method, "approximately" shall be construed to mean that the longer of two adjacent spans shall not exceed the shorter by more than 20 per cent. In these expressions  $l' =$  the clear span for positive moment and the average of the two adjacent clear spans for negative moment.

(a) **Permissible Assumptions.** The span length of freely supported beams and slabs shall be the clear span plus the depth of beam or slab, but shall not exceed the distance between centers of the supports.

In the application of the principle of continuity, the following assumptions shall be permissible:

1. Consideration may be limited to combinations of dead load on all spans with full live load on two adjacent spans and with full live load on alternate spans.

2. Any reasonable and consistent assumption may be made as to the relative stiffness of the floor construction and columns. In computing the relative stiffness of floors to columns, the value  $I$  of the floor members may be based on the entire concrete section neglecting the reinforcement, and that of columns on the entire concrete section plus the transformed steel section. The moment of inertia assumed for the columns in computing bending moments must also be used in computing stresses.

3. The far ends of columns above and below the floor under consideration may be considered fixed.

4. When members are deepened near their ends by haunches they may be analyzed as members of constant section provided the minimum depth is used throughout in computing stresses due to bending; otherwise a complete analysis is required. Where members are widened near their supports the additional width may be neglected in computing moments but may be used in computing stresses.

Additional section at the end may in any case be utilized in resisting shear if properly reinforced.

**Flexural  
Computations  
(Cont'd.)**

5. Where slabs of uniform thickness are built integrally with their supports the span length may be taken equal to the clear span between faces of supports and the width of support otherwise neglected.

6. In the application of the principle of continuity, center-to-center distances may be used in the moment determination of all members.

Moments prevailing at the faces of support may be used to proportion the members at these sections.

7. In slabs other than ribbed floor construction or flat slabs, the principal reinforcement shall not be spaced farther apart than three times the slab thickness.

8. Where analysis indicates negative reinforcement along the full length of a span, the reinforcement need not be extended beyond the point where the required amount is  $.0025 b'd$  or less.

9. In structural slabs of uniform thickness the minimum amount of reinforcement in the direction of principal stress shall be

|  |            |
|--|------------|
| For structural, intermediate and hard grades |            |
| and rail steel .....                         | $.0025 bd$ |
| For steel having a minimum yield point of    |            |
| 56,000 p.s.i. ....                           | $.002 bd$  |

(b) **Distance between Lateral Supports.** The clear distance between lateral supports of a beam shall not exceed 32 times the least width of compression flange.

(c) **Depth of Beam or Slab.** The depth of the beam or slab shall be taken as the distance from the centroid of the tensile reinforcement to the compression face of the structural member. Any floor finish not placed monolithically with the floor slab shall not be included as a part of the structural member. When the finish is placed monolithically with the structural slab in buildings of the warehouse or industrial class, the over-all depth shall be at least one-half inch ( $\frac{1}{2}$ " ) over that required by the design of the member.

(d) **Requirements for T-Beams.** Requirements shall be as follows:

1. In T-beam construction the slab and beam shall be built integrally or otherwise effectively bonded together. The effective flange width to be used in the design of symmetrical T-beams shall not exceed one-fourth of the span length of the beam, and its overhanging width on either side of the web shall not exceed eight times the thickness of the slab nor one-half the clear distance to the next beam.

2. For beams having a flange on one side only, the effective overhanging flange width shall not exceed one-twelfth of the span length of the beam, nor six times the thickness of the slab, nor one-half the clear distance to the nearest beam.

3. Where the principal reinforcement in a slab which is considered as the flange of a T-beam (not a rib in ribbed

**Flexural  
Computations  
(Cont'd.)**

floors) is parallel to the beam, transverse reinforcement shall be provided in the top of the slab. This reinforcement shall be designed to carry the load on the portion of the slab assumed as the flange of the T-beam. The spacing of the bars shall not exceed five times the thickness of the flange, nor in any case eighteen inches (18").

4. Provisions shall be made for the compressive stress at the support in continuous T-beam construction, care being taken that the provisions of Section 2610 relating to the spacing of bars, and Section 2609 (e) relating to the placing of concrete, shall be fully met.

5. The overhanging portion of the flange of the beam shall not be considered as effective in computing the shear and diagonal tension resistance of T-beams.

6. Isolated beams in which the T-form is used only for the purpose of providing additional compression area, shall have a flange thickness not less than one-half the width of the web and a total flange width not more than four times the web thickness.

**(e) One-Way Ribbed Floor Construction.** Construction shall conform to the following requirements:

1. Ribbed floor construction consists of concrete ribs and slabs placed monolithically with or without burned clay or concrete tile fillers. The ribs shall not be farther apart than thirty inches (30") face to face. The ribs shall be straight, not less than four inches (4") wide, nor of a depth more than three times the width.

2. When burned clay or concrete tile fillers, of material having a unit compressive strength at least equal to that of the designed strength of the concrete in the ribs, are used, and the fillers are so placed that the joints in alternate rows are staggered, the shells of the fillers in contact with the ribs may be included in the calculations involving shear or negative bending moment. No other portion of the fillers may be included in the design calculations.

3. The concrete slab over the fillers shall be not less than one and one-half inches ( $1\frac{1}{2}$ ") in thickness, nor less in thickness than one-twelfth of the clear distance between ribs. Shrinkage reinforcement in the slab shall be provided as specified in Section 2615.

4. Where removable forms or fillers not complying with paragraph 2 of this Subsection are used, the thickness of the concrete slab shall be not less than one-twelfth of the clear distance between ribs and in no case less than two inches (2"). Such slab shall be reinforced at right angles to the ribs with a minimum of .049 square inches of reinforcing steel per foot of width, and in slabs on which the prescribed live load does not exceed 50 pounds per square foot, no additional reinforcement will be required.

5. When the finish used as a wearing surface is placed



monolithically with the structural slab in buildings of the warehouse or industrial class, the thickness of the concrete over the fillers shall be one-half inch ( $\frac{1}{2}$ " ) greater than the thickness used for design purposes.

6. Where the slab contains conduits or pipes, the thickness shall be not less than one inch (1" ) plus the total over-all depth of such conduits or pipes at any point. Such conduits or pipes shall be so located as not to impair the strength of the construction.

(f) **Compression Steel in Flexural Members.** Compression steel in beams, girders, or slabs shall be anchored by ties or stirrups not less than one-fourth inch ( $\frac{1}{4}$ " ) in diameter, spaced no farther apart than 16 bar diameters or 48 tie diameters. Such ties or stirrups shall be used throughout the distance where compression steel is required.

The effectiveness of compression reinforcement in resisting bending may be taken at twice the value indicated from calculations assuming a straight line relation between stress and strain and the modular ratio given in Section 2611, but not of greater value than the allowable stress in tension.

**Sec. 2615.** Reinforcement for shrinkage and temperature stresses normal to the principal reinforcement shall be provided in floor and roof slabs where the principal reinforcement extends in one direction only. Such reinforcement shall provide for the following minimum ratios of reinforcement area to concrete area ( $bd$ ), but in no case shall such reinforcing bars be placed farther apart than five times the slab thickness nor more than eighteen inches (18") :

#### Shrinkage and Temperature Reinforcement

|  |        |
|--|--------|
| Floor slabs where plain bars are used .....  | 0.0025 |
| Floor slabs where deformed bars are used .....   | 0.002  |
| Floor slabs where wire fabric is used, having welded intersections not farther apart in the direction of stress than 12 inches ..... | 0.0018 |
| Roof slabs where plain bars are used .....   | 0.003  |
| Roof slabs where deformed bars are used .....  | 0.0025 |
| Roof slabs where wire fabric is used, having welded intersections not farther apart in the direction of stress than 12 inches .....  | 0.0022 |

**Sec. 2616. (a) General.** This construction, consisting of floors reinforced in two directions and supported on four sides, includes solid reinforced concrete slabs, concrete joists with fillers of hollow concrete units or clay tile, with or without concrete top slabs; and concrete joists with top slabs placed monolithically with the joists. The slab shall be supported by walls or beams on all sides and if not securely attached to supports, shall be reinforced as specified in Subsection (b).

#### Two-Way Slabs

(b) **Reinforcement.** Where the slab is not securely attached to the supporting beams or walls, special reinforcement shall be provided at exterior corners in both the bottom and top of the slab. This reinforcement shall be provided for a

**Two-Way  
Slabs  
(Cont'd.)**

distance in each direction from the corner equal to one-fifth the longest span. The reinforcement in the top of the slab shall be parallel to the diagonal from the corner. The reinforcement in the bottom of the slab shall be at right angles to the diagonal or may be of bars in two directions parallel to the sides of the slab. The reinforcement in each band shall be of equivalent size and spacing to that required for the maximum positive moment in the slab.

(c) **Design.** The slab and its supports shall be designed by approved methods which shall take into account the effect of continuity at supports, the ratio of length to width of slab and the effect of two-way action.

(d) **Slab Thickness.** In no case shall the slab thickness be less than four inches (4") nor less than the perimeter of the slab divided by 180. The spacing of reinforcement shall be not more than three times the slab thickness and the ratio of reinforcement shall be at least 0.0025.

(e) **Details.** The details of design of two-way slabs shall conform to U.B.C. Standard No. 26-13.

**Shear and  
Diagonal  
Tension**

**Sec. 2617. (a) Shearing Unit Stress.** The shearing unit stress ( $v$ ) in reinforced concrete flexural members shall be computed by Formula (2):

$$v = \frac{V}{bjd} \dots\dots\dots (2)$$

For beams of I- or T- section  $b'$  shall be substituted for  $b$  in Formula (2).

In ribbed construction, where burned clay or concrete tile are used,  $b'$  may be taken as a width equal to the thickness of the concrete web plus the thickness of the vertical shells of the concrete or burned clay tile in contact with the joist as specified in Sections 2614 and 2616.

Where the value of the shearing unit stress computed by Formula (2) exceeds the shearing unit stress ( $v_c$ ) permitted on the concrete of an unreinforced web (see Section 2613), web reinforcement shall be provided to carry the excess.

(b) **Types of Web Reinforcement.** Web reinforcement may consist of:

1. Stirrups or web reinforcement bars perpendicular to the longitudinal steel.
2. Stirrups or web reinforcement bars welded or otherwise rigidly attached to the longitudinal steel and making an angle of 30 degrees or more thereto.
3. Longitudinal bars bent so that the axis of the inclined portion of the bar makes an angle of 15 degrees or more with the axis of the longitudinal portion of the bar.
4. Special arrangements of bars with adequate provisions to prevent slip of bars or splitting of the concrete by the reinforcement. [See Subsection (d), last paragraph.]

Stirrups or other bars to be considered effective as web reinforcement shall be anchored at both ends, according to the provisions of Section 2618.

(c) **Stirrups.** The area of steel required in stirrups placed perpendicular to the longitudinal reinforcement shall be computed by Formula (3):

**Shear and  
Diagonal  
Tension  
(Cont'd.)**

$$A_s = \frac{V's}{f_v j d} \dots\dots\dots (3)$$

Inclined stirrups shall be proportioned by Formula (5).

Stirrups placed perpendicular to the longitudinal reinforcement shall not be used alone as web reinforcement when the shearing unit stress ( $v$ ) exceeds  $0.08f'_c$ .

(d) **Bent Bars.** When the web reinforcement consists of a single bent bar or of a single group of bent bars the required area of such bars shall be computed by Formula (4):

$$A_s = \frac{V'}{f_v \sin \alpha} \dots\dots\dots (4)$$

In Formula (4)  $V'$  shall not exceed  $0.40f'_c b j d$ .

Only the center three-fourths of the inclined portion of such bar, or group of bars, shall be considered effective as web reinforcement.

Where there is a series of parallel bent bars, the required area shall be determined by Formula (5):

$$A_s = \frac{V's}{f_v j d (\sin \alpha + \cos \alpha)} \dots\dots\dots (5)$$

When bent bars having a radius of bend of not more than two times the diameter of the bar are used alone as web reinforcement, the allowable shearing unit stress shall not exceed  $0.060f'_c$ . This shearing unit stress may be increased at the rate of  $0.01f'_c$  for each increase of four bar diameters in the radius of bend until the maximum allowable shearing unit stress is reached. (See Section 2613.)

The shearing unit stress permitted when special arrangements of bars are employed shall be that determined by making comparative tests, to destruction, of specimens of the proposed system and of similar specimens reinforced in conformity with the provisions of this Code, the same factor of safety being applied in both cases.

(e) **Combined Web Reinforcement.** Where more than one type of reinforcement is used to reinforce the same portion of the web, the total shearing resistance of this portion of the web shall be assumed as the sum of the shearing resistances computed for the various types separately. In such computations the shearing resistance of the concrete shall be included only once, and no one type of reinforcement

shall be assumed to resist more than  $\frac{2V'}{3}$

(f) **Spacing of Web Reinforcement.** Where web reinforcement is required it shall be so spaced that every 45-degree line (representing a potential crack) extending from the

**Shear and  
Diagonal  
Tension  
(Cont'd.)**

mid-depth of the beam to the longitudinal tension bars shall be crossed by at least one line of web reinforcement. If a unit shearing stress in excess of  $0.06f'_c$  is used, every such line shall be crossed by at least two such lines of web reinforcement.

(g) **Shearing Stress in Flat Slabs.** In flat slabs, the shearing unit stress on a vertical section which lies at a distance  $t_1 - 1\frac{1}{2}$  inches beyond the edge of the column capital and parallel with it, shall not exceed the following values when computed by Formula (2) (in which  $d$  shall be taken as  $t_1 - 1\frac{1}{2}$  inches):

1.  $0.03 f'_c$ , when at least 50 per cent of the total negative reinforcement in the column strip passes directly over the column capital.

2.  $0.025 f'_c$ , when 25 per cent of the total negative reinforcement in the column strip passes directly over the column capital.

3. For intermediate percentages, intermediate values of the shearing unit stress shall be used.

In flat slabs, the shearing unit stress on a vertical section which lies at a distance of  $t_2 - 1\frac{1}{2}$  inches beyond the edge of the dropped panel and parallel with it shall not exceed  $0.03f'_c$  when computed by Formula (2) in which  $d$  shall be taken as  $t_2 - 1\frac{1}{2}$  inches. At least 50 per cent of the cross-sectional area of the negative reinforcement in the column strip must be within the width of strip directly above the dropped panel.

(h) **Shear and Diagonal Tension in Footings.** In isolated footings the shearing unit stress computed by Formula (2) on the critical section [see Sec. 2621 (d)] shall not exceed  $0.03f'_c$ , nor in any case shall it exceed 75 pounds per square inch.

**Bond and  
Anchorage**

**Sec. 2618. (a) Computation of Bond Stress in Beams.** In flexural members in which the tensile reinforcement is parallel to the compression face, the bond stress at any cross section shall be computed by Formula (6):

$$u = \frac{V}{\sum_o j d} \dots\dots\dots (6)$$

in which  $V$  is the shear at that section.

Adequate end anchorage shall be provided for the tensile reinforcement in all flexural members to which Formula (6) does not apply, such as footings, brackets, and other tapered or stepped beams in which the tensile reinforcement is not parallel to the compression face.

(b) **Anchorage Requirements.** Tensile negative reinforcement in any span of a continuous, restrained, or cantilever beam, or in any member of a rigid frame shall be adequately anchored by bond, hooks, or mechanical anchors in or through the supporting member. Within any such span every reinforcing bar shall be extended at least 12 diameters beyond the point at which it is no longer needed to resist stress.

The maximum tension in any bar must be developed by bond on a sufficient straight or bent embedment or by other anchorage [see Section 2618 (f)]. **Bond and Anchorage (Cont'd.)**

Of the positive reinforcement in continuous beams not less than one-fourth the area shall extend along the same face of the beam into the support a distance of six inches (6").

In simple beams, or at the freely supported end of continuous beams, at least one-third the required positive reinforcement shall extend along the same face of the beam into the support a distance of six inches (6").

(c) **Plain Bars in Tension.** Plain bars in tension shall terminate in standard hooks except that hooks shall not be required on the positive reinforcement at interior supports of continuous members.

(d) **Anchorage of Web Reinforcement.** Single separate bars used as web reinforcement shall be anchored at each end by one of the following methods:

1. Welding to longitudinal reinforcement.
2. Hooking tightly around the longitudinal reinforcement through 180 degrees.
3. Embedment in the compression area of the beam a distance sufficient to develop the allowable tensile stress specified in Section 2613 at a bond stress not exceeding 0.045 $\frac{f_c}{f_t}$  on plain bars, nor 0.10 $\frac{f_c}{f_t}$  on deformed bars.
4. Standard hook, considered as developing 10,000 pounds per square inch, plus embedment sufficient to develop by bond the remainder of the stress to which the bar is subjected. The unit bond stress shall not exceed that set forth in Table No. 26-B. The effective embedded length shall not be assumed to exceed the distance between the mid-depth of the beam and the tangent of the hook.

The extreme ends of bars forming simple U or multiple stirrups shall be anchored by one of the methods of Subsection (d) or shall be bent through an angle of at least 90 degrees tightly around a longitudinal reinforcing bar not less in diameter than the stirrup bar, and shall project beyond the bend at least 12 diameters of the stirrup bar.

The loops or closed ends of such stirrups shall be anchored by bending around the longitudinal reinforcement through an angle of at least 90 degrees, or by being welded or otherwise rigidly attached thereto.

Hooking or bending stirrups or separate web reinforcement bars around the longitudinal reinforcement shall be considered effective only when these bars are perpendicular to the longitudinal reinforcement.

Longitudinal bars bent to act as web reinforcement shall, in a region of tension, be continuous with the longitudinal reinforcement. The tensile stress in each bar shall be fully developed in both the upper and the lower half of the beam by one of the following methods:

**Bond and Anchorage  
(Cont'd.)**

I. As specified in Subsection (d) 3.

II. As specified in Subsection (d) 4.

III. By bond, at unit bond stress not exceeding 0.045% on plain bars nor 0.10% on deformed bars, a bend of radius not less than two times the diameter of the bar, plus an extension of the bar parallel to the upper or lower surface of the beam, of not less than 12 diameters of the bar, plus a standard hook. This short radius bend extension and hook shall together not be counted upon to develop a tensile unit stress in the bar of more than 10,000 pounds per square inch.

IV. By bond, at a unit bond stress not exceeding 0.045% on plain bars nor 0.10% on deformed bars, plus a bend of radius not less than two times the diameter of the bar, parallel to the upper or lower surface of the beam and continuous with the longitudinal reinforcement. The short radius bend and continuity shall together not be counted upon to develop a tensile unit stress in the bar of more than 10,000 pounds per square inch.

V. The tensile unit stress at the beginning of a bend may be increased from 10,000 pounds per square inch when the radius of bend is two bar diameters, at the rate of 1000 pounds per square inch tension for each increase of one and one-half bar diameters in the radius of bend, provided that the length of the bar in the bend and extension is sufficient to develop this increased tensile stress by bond at the unit stresses given in Subsection (d) III.

In all cases web reinforcement shall be carried as close to the compression surface of the beam as fire-protection regulations and the proximity of other steel will permit.

(e) **Anchorage of Bars in Footing Slabs.** Plain bars in footing slabs, except the longitudinal reinforcement between loads in continuous-slab footings, shall be anchored by means of standard hooks. The outer faces of these hooks and the ends of deformed bars shall be not less than three inches (3") nor more than six inches (6") from the face of the footing.

(f) **Hooks.** The terms "hook" or "standard hook" as used herein shall mean a complete semicircular turn with a radius of bend on the axis of the bar of not less than three and not more than six bar diameters, plus an extension of at least four bar diameters at the free end of the bar or a 90-degree bend having a radius of not less than four bar diameters plus an extension of 12 bar diameters. Hooks having a radius of bend of more than six bar diameters shall be considered merely as extensions to the bars, and shall be treated as in Subsection (d) V.

In general, hooks shall not be permitted in the tension portion of any beam except at the ends of simple or cantilever beams or at the freely supported ends of continuous or restrained beams.

No hook shall be assumed to carry a load which would produce a tensile stress in the bar greater than 10,000 pounds per square inch.

Hooks shall not be considered effective in adding to the compressive resistance of bars.

Any mechanical device capable of developing the strength of the bar without damage to the concrete may be used in lieu of a hook. Tests must be presented to show the adequacy of such devices.

**Sec. 2619. (a) Scope.** The term "flat slab" shall mean a reinforced concrete slab supported by columns with or without flaring heads or column capitals, with or without depressed or drop panels and generally without beams or girders. Recesses or pockets in flat-slab ceilings, located between reinforcing bars and forming cellular or two-way ribbed ceilings, whether left open or filled with permanent fillers, shall not prevent a slab from being considered a flat slab; but allowable unit stresses shall not be exceeded. **Flat Slabs**

**(b) Design of Flat Slabs as Continuous Frames.** Any type of flat-slab construction may be designed by application of the principles of continuity.

**(c) Design of Flat Slabs by Moment Coefficients.** Arbitrary coefficients may be used when the construction conforms with the following:

1. The ratio of length to width of panel does not exceed 1:33.
2. The slab is continuous for at least three panels in each direction.
3. The successive span lengths in each direction differ by not more than 20 per cent of the shorter span.

**(d) Details.** The details of the design and construction of flat slabs shall conform to U.B.C. Standard No. 26-14.

**Sec. 2620. (a) Limiting Dimensions.** The following Subsections on reinforced concrete and composite columns except Subsection (g) apply to a short column, for which the unsupported length is not greater than 10 times the least lateral dimension. When the unsupported length exceeds this value, the design shall be modified as shown in Subsection (g). Principal columns in buildings shall have a minimum diameter of twelve inches (12"), or in the case of rectangular columns, a minimum thickness of ten inches (10") and a minimum gross area of one hundred and twenty square inches (120 sq. in.). Posts that are not continuous from story to story shall have a minimum diameter or thickness of six inches (6"). **Reinforced Concrete Columns and Walls**

**(b) Unsupported Length of Columns.** For purposes of determining the limiting dimensions of columns, the unsupported length of reinforced concrete columns shall be taken as the clear distance between floor slabs.

**EXCEPTIONS:** 1. In flat-slab construction, it shall be the clear distance between the floor and the lower extremity of the capital.

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(Cont'd.)**

2. In beam-and-slab construction, it shall be the clear distance between the floor and the under side of the deeper beam framing into the column in each direction at the next higher floor level.

3. In columns restrained laterally by struts, it shall be the clear distance between consecutive struts in each vertical plane; provided that to be an adequate support, two such struts shall meet the column at approximately the same level, and the angle between vertical planes through the struts shall not vary more than 15 degrees from a right angle. Such struts shall be of adequate dimensions and anchorage to restrain the column against lateral deflection.

4. In columns restrained laterally by struts or beams, with brackets used at the junction, it shall be the clear distance between the floor and the lower edge of the bracket, provided that the bracket width equals that of the beam or strut and is at least half that of the column.

For rectangular columns, that length shall be considered which produces the greatest ratio of length to depth of section.

(c) **Spirally Reinforced Columns.** 1. **Permissible load.** The maximum permissible axial load,  $P$ , on columns with closely spaced spirals enclosing a circular concrete core reinforced with longitudinal bars shall be that given by Formula (7):

$$P = A_g (0.225f'_c + f_s p_s) \dots\dots\dots (7)$$

**WHERE**

$A_g$  = the gross area of the column.

$f'_c$  = compressive strength of the concrete.

$f_s$  = nominal working stress in vertical column reinforcement, to be taken at 40 per cent of the minimum specification value of the yield point; viz., 16,000 pounds per square inch for intermediate-grade steel and 20,000 pounds per square inch for rail or hard-grade steel.\*

$p_s$  = ratio of the effective cross-sectional area of vertical reinforcement to the gross area,  $A_g$ .

2. **Vertical reinforcement.** The ratio ( $p_s$ ) shall be not less than 0.01 nor more than 0.08. The minimum number of bars shall be six, and the minimum diameter shall be five-eighths inch ( $\frac{5}{8}$ " ). The center-to-center spacing of bars within the periphery of the column core shall be not less than two and one-half times the diameter for round bars or

\*Nominal working stresses for reinforcement of higher yield point may be established at 40 per cent of the yield point stress, but not more than 30,000 pounds per square inch, when the properties of such reinforcing steels have been definitely specified. If this is done, the lengths of splice required by Section 2620 (c) 3 shall be increased accordingly.



three times the side dimension for square bars. The clear spacing between bars shall be not less than one and one-half inches ( $1\frac{1}{2}$ " ), or one and one-half times the maximum size of the coarse aggregate used. These spacing rules apply to adjacent pairs of bars at a lapped splice.

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(Cont'd.)**

3. **Splices in vertical reinforcement.** Where lapped splices in the column verticals are used, the minimum amount of lap shall be as follows:

I. For deformed bars with concrete having an ultimate strength of 3000 pounds per square inch or above, 20 diameters of bar of intermediate or hard-grade steel. For bars of higher yield point, the amount of lap shall be increased one diameter for each 1000 pounds per square inch above 20,000 pounds per square inch working stress. When the concrete strengths are less than 3000 pounds per square inch, the amount of lap shall be one-third greater than the values given above.

II. For plain bars the minimum amount of lap shall be 100 per cent greater than that specified for deformed bars.

III. Welded splices or other positive connections may be used instead of lapped splices. Welded splices shall preferably be used in cases where the bar diameter exceeds one and one-half inch ( $1\frac{1}{2}$ " ). An approved welded splice shall be defined as one in which the bars are butted and welded and that will develop in tension at least the yield point stress of the reinforcing steel used.

IV. Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded by a concrete capital, floor slab, or metal ties or reinforcing spirals. Where bars are offset, the slope of the inclined portion from the axis of the column shall not exceed one in six and the bars above and below the offset shall be parallel to the axis of the column.

4. **Spiral reinforcement.** The ratio of spiral reinforcement ( $p'$ ) shall be not less than the value given by Formula (8):

$$p' = 0.45 (R - 1) \frac{f'_s}{f'_c} \dots\dots\dots (8)$$

**WHERE**

$p'$  = ratio of volume of spiral reinforcement to the volume of the concrete core (out to out of spirals).

$R$  = ratio of gross area to core area of column,  $A_g/A_c$ .

$f'_s$  = useful limit stress of spiral reinforcement, to be taken as 40,000 pounds per square inch for hot-rolled rods of intermediate grade, 50,000 pounds per square inch for hard grade, and 60,000 pounds per square inch for cold-drawn wire.

The spiral reinforcement shall consist of evenly spaced continuous spirals held firmly in place and true to line by vertical spacers using at least two for spirals twenty inches

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(20") or less in diameter, three for spirals twenty inches (20") to thirty inches (30") in diameter, and four for spirals more than thirty inches (30") in diameter or composed of spiral rods five-eighths inch ( $\frac{5}{8}$ ") or larger in size. The spirals shall be of such size and so assembled as to permit handling and placing without being distorted from the design dimensions. The material used in spirals shall have a minimum diameter of one-fourth inch ( $\frac{1}{4}$ ") for rolled bars or No. 4 W.&M. gauge for drawn wire. Anchorage of spiral reinforcement shall be provided by one and one-half extra turns of spiral rod or wire at each end of the spiral unit. Splices, when necessary, shall be made in spiral rod or wire by welding or by a lap of one and one-half turns. The center-to-center spacing of the spirals shall not exceed one-sixth of the core diameter. The clear spacing between spirals shall not exceed three inches (3") nor be less than one and three-eighths inches ( $1\frac{3}{8}$ ") or one and one-half times the maximum size of coarse aggregate used. The reinforcing spiral shall extend from the floor level in any story, or from the top of the footing in the basement, to the level of the lowest horizontal reinforcement in the slab, dropped panel, or beam above. In a column with a capital, it shall extend to the plane at which the diameter or width of the capital is twice that of the column.

**5. Protection of reinforcement.** The column reinforcement shall be protected everywhere by a covering of concrete cast monolithically with the core, for which the thickness shall be not less than one and one-half inches ( $1\frac{1}{2}$ ") nor less than one and one-half times the maximum size of the coarse aggregate, nor shall it be less than required by the fire-protection and weathering provisions specified in Section 2610 (f).

**6. Limits of column section.** For columns built monolithically with concrete walls or piers, the outer boundary of the column section shall be taken either as a circle at least one and one-half inches ( $1\frac{1}{2}$ ") outside the column spiral or as a square or rectangle of which the sides are at least one and one-half inches ( $1\frac{1}{2}$ ") outside the spiral. The value of  $A_g$  thus defined shall be used in both Formulas (7) and (8). In any case it shall be permissible to design a circular column and to build it as a square column of the same least lateral dimension. In such case the permissible load, the gross area considered, and the required percentage of reinforcement must be taken as those of the circular column.

(d) **Tied Columns. 1. Permissible load.** The maximum permissible axial load on columns reinforced with longitudinal bars and separate lateral ties shall be 80 per cent of that given by Formula (7). The ratio ( $p_g$ ) to be considered in tied columns shall be not less than 0.01 nor more than 0.04. The longitudinal reinforcement shall consist of at least four bars, of minimum diameter of five-eighths inch ( $\frac{5}{8}$ "). Splices in reinforcing bars shall be made as described in Subsection (c) 3.

**2. Lateral ties.** Lateral ties shall be at least one-fourth

inch ( $\frac{1}{4}$ " ) in diameter and shall be spaced apart not over 16 bar diameters, 48 tie diameters or the least dimension of the column. When there are more than four vertical bars, additional ties shall be provided so that every longitudinal bar is held firmly in its designed position and has lateral support equivalent to that provided by a 90-degree corner of a tie.

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(Cont'd.)**

3. **Limits of column section.** In a tied column which for architectural reasons has a larger cross section than required by consideration of loading, a reduced effective area ( $A_e$ ) not less than one-half of the total area may be used in applying the provisions of Subsection (d) 1.

(e) **Composite Columns.** 1. **Permissible load.** The permissible load on a composite column consisting of a structural steel or cast-iron column thoroughly encased in concrete reinforced with both longitudinal and spiral reinforcement, shall not exceed that given by Formula (9):

$$P = 0.225A_c f'_c + f_s A_s + f_r A_r \text{ .....(9)}$$

**WHERE**

$A_c$  = net area of concrete

$$= A_g - A_s - A_r.$$

$A_s$  = cross-sectional area of longitudinal bar reinforcement.

$A_r$  = cross-sectional area of the steel or cast-iron core.

$f_r$  = permissible unit stress in metal core, not to exceed 16,000 pounds per square inch for a steel core; or 10,000 pounds per square inch for a cast-iron core.

The remaining notation is that of Subsection (c).

2. **Details of metal core and reinforcement.** The cross-sectional area of the metal core shall not exceed 20 per cent of the gross area of the column. If a hollow metal core is used it shall be filled with concrete. The amounts of longitudinal and spiral reinforcement and the requirements as to spacing of bars, details of splices, and thickness of protective shell outside the spiral shall conform to the limiting values specified in Subsection (c), paragraphs 2, 3, 4, and 5. A clearance of at least three inches (3") shall be maintained between the spiral and the metal core at all points, except that when the core consists of a structural steel H-column the minimum clearance may be reduced to two inches (2").

3. **Splices and connections of metal cores.** Metal cores in composite columns shall be accurately milled at splices and positive provision shall be made for alignment of one core above another. At the column base, provision shall be made to transfer the load to the footing at safe unit stresses in accordance with Section 2613 and Table No. 26-B. The base of the metal section shall be designed to transfer the load from the entire composite column to the footing, or it may be designed to transfer the load from the metal section only, provided it is so placed in the pier or pedestal as to leave ample section of concrete above the base for the transfer

**Reinforced  
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of load from reinforced concrete section of the column by means of bond on the vertical reinforcement and by direct compression on the concrete. Transfer of loads to the metal core shall be provided for by the use of bearing members such as billets, brackets, or other positive connections; these shall be provided at the top of the metal core and at intermediate floor levels where required. The column as a whole shall satisfy the requirements of Formula (9) at any point; in addition to this, the reinforced concrete portion shall be designed to carry, in accordance with Formula (7), all floor loads brought onto the column at levels between the metal brackets or connections. In applying Formula (7), the value of  $A_g$  shall be interpreted as the area of the concrete section outside the metal core, and the permissible load on the reinforced concrete section shall be further limited to  $0.35f'_cA_g$ . Ample section of concrete and continuity of reinforcement shall be provided at the junction with beams or girders.

**4. Permissible load on metal core only.** The metal cores of composite columns shall be designed to carry safely any construction or other loads to be placed upon them prior to their encasement in concrete.

**(f) Combination Columns. 1. Steel columns encased in concrete.** The permissible load on a structural steel column which is encased in concrete at least two and one-half inches ( $2\frac{1}{2}$ " ) thick over all metal (except rivet heads) reinforced as hereinafter specified, shall be computed by Formula (10):

$$P = A_r f'_r \left( 1 + \frac{A_s}{100 A_r} \right) \dots\dots\dots (10)$$

**WHERE**

$A_r$  = cross-sectional area of steel column.  
 $f'_r$  = permissible stress for unencased steel column.  
 $A_g$  = total area of concrete section.

The concrete used shall develop a compressive strength ( $f'_c$ ) of at least 2000 pounds per square inch at 28 days. The concrete shall be reinforced by the equivalent of welded-wire mesh having wires of No. 10 W. & M. gauge, the wires encircling the column being spaced not more than four inches (4") apart and those parallel to the column axis not more than eight inches (8") apart. This mesh shall extend entirely around the column at a distance of one inch (1") inside the outer concrete surface and shall be lap-spliced at least 40 wire diameters and wired at the splice. Special brackets shall be used to receive the entire floor load at each floor level. The steel column shall be designed to carry safely any construction or other loads to be placed upon it prior to its encasement in concrete.

**2. Pipe columns.** The permissible load on columns consisting of steel pipe filled with concrete shall be determined by Formula (11):

$$P = 0.225f'_cA_c + f'_rA_r \dots\dots\dots (11)$$

The value of  $f_r$  shall be that given by Formula (12):

$$f_r = \left( 18,000 - 70 \frac{h}{K} \right) F \dots \dots \dots (12)$$

**Reinforced  
Concrete  
Columns  
and Walls  
(Cont'd.)**

WHERE

$f_r$  = average unit stress in metal core.

$h$  = unsupported length of column.

$K$  = least radius of gyration of metal core section.  
(yield point of pipe)

$$F = \frac{\quad}{45,000}$$

If the yield point of the pipe is not known, the factor  $F$  shall be taken as 0.5.

(g) **Long Columns.** The maximum permissible load  $P'$  on axially loaded reinforced concrete or composite columns having a length, ( $h$ ), greater than 10 times the least lateral dimension, ( $d$ ), shall be given by Formula (13):

$$P' = P \left( 1.3 - .03 \frac{h}{d} \right) \dots \dots \dots (13)$$

where  $P$  is the permissible axial load on a short column as given by Subsections (c), (d), and (e).

The maximum permissible load  $P'$  on eccentrically loaded columns in which  $\frac{h}{d}$  exceeds 10 shall also be given by

Formula (13) in which  $P$  is the permissible eccentrically applied load on a short column as determined by the provisions of Subsections (i) and (j). In long columns subjected to definite bending stresses, as determined in Subsection (h), the ratio  $h/d$  shall not exceed 20.

(h) **Bending Moments in Columns.** When the stiffness and strength of the columns are utilized to reduce moments in beams, girders, or slabs, as in the case of rigid frames, or in other forms of continuous construction wherein column moments are unavoidable, they shall be provided for in the design. In computing moments in columns, the far ends may be considered fixed. Columns shall be designed to resist the axial forces from loads on all floors, plus the maximum bending due to loads on a single adjacent span of the floor under consideration.

(i) **Determination of Combined Axial and Bending Stresses.** In a reinforced concrete column, designed by the methods of this Chapter, which is (1) symmetrical about two perpendicular planes through its axis and (2) subject to an axial load,  $N$ , combined with bending in one or both of the planes of symmetry (but with the ratio of eccentricity to depth,  $e/t$ , no greater than 1.0 in either plane), the combined fiber stress in compression may be computed on the basis of recognized theory applying to uncracked sections, using Formula (14):

**Reinforced  
Concrete  
Columns  
and Walls  
(Cont'd.)**

$$f'_c = \frac{N}{A_s} \left[ \frac{1 + \frac{De}{t}}{1 + (n-1)p_s} \right] \dots\dots\dots (14)$$

WHERE

$D = \frac{t^2}{2R^2}$  = a factor, usually varying from 3 to 9. (The term  $R$  as used here is the radius of gyration of the entire column section.)

$t$  = over-all depth of column section.

Equating this calculated stress,  $f'_c$ , to be the allowable stress,  $f_p$ , in Formula (16) it follows that the column can be designed for an equivalent axial load,  $P$ , as given by Formula (15):\*

$$P = N \left[ 1 + \frac{C De}{t} \right] \dots\dots\dots (15)$$

WHERE

$C$  = ratio of allowable concrete stress,  $f_a$ , in axially loaded column to allowable fiber stress for concrete in flexure.

When bending exists on both axes of symmetry, the quantity  $\frac{De}{t}$  shall be computed as the numerical sum of the

$\frac{De}{t}$  — quantities in the two directions.

For columns in which the load,  $N$ , has an eccentricity,  $e$ , greater than the column depth,  $t$ , or for beams subject to small axial loads, the determination of the fiber stress  $f'_c$  shall be made by use of recognized theory for cracked sections, based on the assumption that no tension exists in the concrete. For such cases the tensile steel stress shall also be investigated.

(j) **Allowable Combined Axial and Bending Stress.** For spiral and tied columns, eccentrically loaded or otherwise subjected to combined axial compression and flexural stress, the maximum allowable compressive stress,  $f_p$ , is given by Formula (16):

$$f_p = f_a \left[ \frac{1 + \frac{De}{t}}{1 + \frac{C De}{t}} \right] = f_a \left[ \frac{t + De}{t + C De} \right] \dots\dots\dots (16)$$

\*For approximate or trial computations,  $D$  may be taken as eight for a circular spiral column and as five for a rectangular tied or spiral column.

## WHERE

Reinforced  
Concrete  
Columns  
and Walls  
(Cont'd.)

$D = \frac{t^2}{2R^2}$  = a factor, usually varying from 3 to 9. (The term  $R$  as used here is the radius of gyration of the entire column section.)

$t$  = over-all depth of column section.

$f_a$  = average allowable stress in the concrete of an axially loaded reinforced concrete column.

$C$  = ratio of  $f_a$  to the allowable fiber stress for members in flexure.

Thus

$$f_a = \left[ \frac{0.225 f'_c + f_a p_g}{1 + (n-1) p_g} \right]$$

for spiral columns and 0.8 of this value for tied columns, and

$$C = \frac{f_a}{0.45 f'_c}$$

For tied columns which are designed to withstand combined axial and bending stresses, the limiting total steel ratio of 0.04 prescribed in Subsection (d) may be increased to 0.08, provided that the amount of steel spliced by lapping shall not exceed a steel ratio of 0.04 in any three-foot (3') length of column. The size of the column designed under this provision shall in no case be less than that required to withstand axial load alone as specified in Subsection (d).

(k) **Walls. 1. Lateral and eccentric loads.** Walls shall be designed for any lateral or other loads to which they are subjected. Proper provision shall be made for eccentric loads.

**2. Height and thickness.** The thickness of reinforced concrete bearing walls shall be not less, and the maximum height, number of stories, and distance between supports shall be not more, than as set forth in Table No. 26-C.

**EXCEPTION:** The provisions of this paragraph may be waived when written evidence is submitted by a qualified person showing that the walls meet all the other requirements of this Code.

**3. Design.** The maximum allowable compressive stress in reinforced concrete bearing walls with minimum reinforcement as required by this Subsection shall not exceed

$$\left[ 1 - \left( \frac{h}{30d} \right)^3 \right] 0.2f'_c \dots\dots\dots (17)$$

When the reinforcement in bearing walls is designed, placed, and anchored in position as for columns, the working stresses shall be on the basis of formulas for columns. For calculating wall stresses, concentrated loads may be assumed to be distributed over a maximum length of wall not exceeding the center to center distance between loads nor five times the width of the bearing.

**TABLE NO. 26-C—REQUIREMENTS FOR REINFORCED CONCRETE BEARING WALLS**

| MAXIMUM HEIGHT<br>(Feet) | STORY    | LIMITING RATIO—<br>DISTANCE BETWEEN<br>SUPPORTS TO WALL<br>THICKNESS | MINIMUM THICKNESS<br>(Inches) |   |   |
|--------------------------|----------|--|-------------------------------|---|---|
| 38                       | 3        | 25   | 6                             |   |   |
|                          | 2        |  | 7                             | 6 |   |
|                          | 1        |  | 7                             | 7 | 6 |
|                          | Basement |  | 8                             | 8 | 8 |

**Reinforced  
Concrete  
Columns  
and Walls  
(Cont'd.)**

Reinforced concrete walls shall be reinforced with an area of steel in each direction, both vertical and horizontal, at least equal to 0.0025 times the cross-sectional area of the wall. Walls more than ten inches (10") in thickness shall have the reinforcement for each direction placed in two layers parallel with the faces of the wall. One layer consisting of not less than one-half and not more than two-thirds the total required reinforcement shall be placed not less than one and one-half inches (1½") nor more than one-third the thickness of the wall from the exterior surface. The other layer, comprising the balance of the required reinforcement shall be placed not less than three-fourths inch (¾") and not more than one-third the thickness of the wall from the interior surface. Bars shall be not less than three-eighths inch (⅜") round, nor shall they be spaced more than eighteen inches (18") on center.

Reinforced concrete walls shall be anchored at all points of lateral support. Such anchorage shall be capable of resisting the horizontal forces with a minimum of 200 pounds per lineal foot.

(1) **Non-Bearing Partitions.** Non-bearing partitions of reinforced concrete shall have a thickness of not less than one forty-eighth of the distance between their supports nor less than two inches (2").

**Footings**

**Sec. 2621. (a) Loads and Reactions.** Footings shall be proportioned to sustain the applied loads and induced reactions without exceeding the allowable stresses as prescribed in Section 2613, and as further provided in this Section and in Section 2624 (e) for plain concrete.

In cases where the footing is concentrically loaded and the member being supported does not transmit any moment to the footing, computations for moments and shears shall be based on an upward reaction assumed to be uniformly distributed per unit area or per pile and a downward applied load assumed to be uniformly distributed over the area of the footing covered by the column, pedestal, wall, or metallic column base.

In cases where the footing is eccentrically loaded or the member being supported transmits a moment to the footing, proper allowance shall be made for any variation that may exist in the intensities of reaction and applied load consist-



ent with the magnitude of the applied load and the amount of its actual or virtual eccentricity. **Footings (Cont'd.)**

In the case of footings on piles, computations for moments and shears may be based on the assumption that the reaction from any pile is concentrated at the center of the pile.

**(b) Sloped or Stepped Footings.** In sloped or stepped footings, the angle of slope or depth and location of steps shall be such that the allowable stresses are not exceeded at any section.

In sloped or stepped footings, the effective cross section in compression shall be limited by the area above the neutral plane.

Sloped or stepped footings shall be cast as a unit.

**(c) Bending Moment.** The external moment on any section shall be determined by passing through the section a vertical plane which extends completely across the footing, and computing the moment of the forces acting over the entire area of the footing on one side of said plane.

The greatest bending moment required in the design of an isolated footing shall be the moment so computed at sections located as follows:

1. At the face of the column, pedestal, or wall, for footings supporting a concrete column, pedestal, or wall.
2. Halfway between the middle and the edge of the wall, for footings under masonry walls.
3. Halfway between the face of the column or pedestal and the edge of the metallic base, for footings under metallic bases.

The width-resisting compression at any section shall be assumed as the entire width of the top of the footing at the section under consideration.

In one-way reinforced footings, the total tensile reinforcement at any section shall provide a moment of resistance at least equal to the moment computed as specified in this Section, and the reinforcement thus determined shall be distributed uniformly across the full width of the section.

In two-way reinforced footings, the total tensile reinforcement at any section shall provide a moment of resistance at least equal to 85 per cent of the moment computed as specified in this Section, and the total reinforcement thus determined shall be distributed across the corresponding resisting section in the following manner:

In two-way square footings, the reinforcement extending in each direction shall be distributed uniformly across the full width of the footing.

In two-way rectangular footings, the reinforcement in the long direction shall be distributed uniformly across the full width of the footing. In the case of the reinforcement in the short direction, that portion determined by Formula (18) shall be uniformly distributed across a band-width ( $B$ ) centered with respect to the center line of the column or pedestal and having a width equal to the length of the short side

**Footings  
(Cont'd.)**

of the footing. The remainder of the reinforcement shall be uniformly distributed in the outer portion of the footing.

$$\frac{\text{Reinforcement in band-width } (B)}{\text{Total reinforcement in short direction}} = \frac{2}{(S + 1)} \dots\dots(18)$$

where "S" is the ratio of the long side to the short side of the footing.

(d) **Shear and Bond.** The critical section for shear to be used as a measure of diagonal tension shall be assumed as a vertical section obtained by passing a series of vertical planes through the footing, each of which is parallel to a corresponding face of the column, pedestal, or wall and located a distance therefrom equal to the depth for footings on soil, and one-half the depth for footings on piles.

Each face of the critical section shall be considered as resisting an external shear equal to the load on an area bounded by said face of the critical section for shear, two diagonal lines drawn from the column or pedestal corners and making 45-degree angles with the principal axes of the footing, and that portion of the corresponding edge or edges of the footing intercepted between the two diagonals.

Critical sections for bond shall be assumed at the same planes as those prescribed for bending moment in Subsection (c); also at all other vertical planes where changes of section or of reinforcement occur.

Computations for shear to be used as a measure of bond shall be based on the same section and loading as specified for the determination of external bending moment in Subsection (c).

The total tensile reinforcement at any section shall provide a bond resistance at least equal to the bond requirement as computed from the following percentages of the external shear at the section:

1. In one-way reinforced footings, 100 per cent.
2. In two-way reinforced footings, 85 per cent.

In computing the external shear on any section through a footing supported on piles, the entire reaction from any pile whose center is located six inches (6") or more outside the section shall be assumed as producing shear on the section; the reaction from any pile whose center is located six inches (6") or more inside the section shall be assumed as producing no shear on the section. For intermediate positions of the pile center, the portion of the pile reaction to be assumed as producing shear on the section shall be based on straightline interpolation between full value at six inches (6") outside the section and zero value at six inches (6") inside the section.

Shearing and bond stresses shall not exceed those specified in Sections 2613, 2617, and 2618.

(e) **Transfer of Stress at Base of Column.** The stress in the longitudinal reinforcement of a column or pedestal shall

be transferred to its supporting pedestal or footing either by extending the longitudinal bars into the supporting member, or by dowels. **Footings (Cont'd.)**

In case the transfer of stress in the reinforcement is accomplished by extension of the longitudinal bars, they shall extend into the supporting member the distance required to transfer to the concrete, by allowable bond stress, their full working value.

In cases where dowels are used, their total sectional area shall be not less than the sectional area of the longitudinal reinforcement in the member from which the stress is being transferred. In no case shall the number of dowels per member be less than four and the diameter of the dowels shall not exceed the diameter of the column bars by more than one-eighth inch ( $\frac{1}{8}$ " ).

Dowels shall extend up into the column or pedestal a distance at least equal to that specified in Section 2620 (c) 3, for lap of longitudinal column bars and down into the supporting pedestal or footing the distance required to transfer to the concrete, by allowable bond stress, the full working value of the dowel.

The compressive stress in the concrete at the base of a column or pedestal shall be considered as being transferred by bearing to the top of the supporting pedestal or footing. The unit compressive stress on the loaded area shall not exceed the bearing stress allowable for the quality of concrete in the supporting member as limited by the ratio of the loaded area to the supporting area.

Bearing stresses shall not exceed those set forth in Table No. 26-B.

In sloped or stepped footings, the supporting area for bearing may be taken as the top horizontal surface of the footing, or assumed as the area of the lower base of the largest frustum of a pyramid or cone contained wholly within the footing and having for its upper base the area actually loaded, and having side slopes of one vertical to not more than two horizontal.

(f) **Footings Supporting Round Columns.** In computing the stresses in footings which support a round or octagonal concrete column or pedestal, the "face" of the column or pedestal shall be taken as the side of a square having an area equal to the area enclosed within the perimeter of the column or pedestal.

(g) **Minimum Edge-Thickness.** In reinforced concrete footings, the thickness above the reinforcement at the edge shall be not less than six inches (6") for footings on soil, nor less than twelve inches (12") for footings on piles.

**Sec. 2622.** The depth of precast concrete joists shall be not more than four times the width of the top or bottom flanges nor less than one twenty-fourth of the span length. **Precast Concrete Joists**

The thickness of the top slab shall be not less than one-twelfth of the clear span between joists nor less than two

inches (2") for roofs or floors and not less than one and one-half inches (1½") over the joists. The slab shall have not less than 0.2 per cent reinforcement at right angles to the span of joists. The reinforcement shall be spaced not farther apart than five times the slab thickness.

When the top slab is adequately reinforced and bonded to the joist, the construction may be considered as a T-beam.

### Composite Beams

**Sec. 2623.** The term "composite beam" shall apply to any rolled- or fabricated-steel floor beam entirely encased in poured concrete at least four inches (4") wider, at its narrowest point, than the flange of the beam, supporting a concrete slab on each side without openings adjacent to the beam; provided that the top of the beam is at least one and one-half inches (1½") below the top of the slab and at least two inches (2") above the bottom of the slab; provided that a good grade of stone or gravel concrete with portland cement is used; and provided that the concrete has adequate mesh, or other reinforcing steel, throughout its whole depth and across the soffit.

Composite beams may be figured on the assumption that:

1. The steel beam carries unassisted all dead loads prior to the hardening of the concrete, with due regard for any temporary support provided.

2. The steel and concrete carry by joint action all loads, dead and live, applied after the hardening of the concrete.

The total tensile unit stress in the extreme fiber of the steel beam thus computed shall not exceed 20,000 pounds per square inch. (See Section 2702.)

The maximum stresses in concrete, and the ratio of Young's moduli for steel and concrete, shall be as prescribed by the specifications governing the design of reinforced concrete for the structure.

The web and end connections of the steel beam shall be adequate to carry the total dead and live load without exceeding the unit stresses prescribed in this Code, except as this may be reduced by the provision for other proper support.

### Plain Concrete

**Sec. 2624. (a) General.** Plain concrete, other than fill, shall have a minimum ultimate compressive strength at 28 days of 2000 pounds per square inch, and material, proportioning, and placing shall conform to the requirements of this Chapter. Concrete made with lightweight aggregates may be used with strengths less than 2000 pounds per square inch if it has been shown by tests or experience to have sufficient strength and durability.

Provisions shall be made to care for temperature and shrinkage stresses either by use of reinforcement or by means of joints.

Plain concrete construction shall conform to the detailed minimum requirements specified in this Chapter. Where Section 2312 is applicable, plain concrete shall also be

designed in accordance with the allowable stresses specified in this Chapter.

**Plain  
Concrete  
(Cont'd.)**

(b) **Wall Thickness.** The thickness of plain concrete walls may be two inches (2") less than required by Section 2417(b) for plain masonry walls but in no case less than seven inches (7"), and the ratio of unsupported height or length (whichever is the lesser) to thickness shall be not greater than 22.

(c) **Design.** Plain concrete walls shall be designed to withstand all vertical and horizontal loads as specified in Chapter 23.

(d) **Stresses.** The allowable working stresses in plain concrete walls shall not exceed the following percentages of ultimate strength:

|                   |            |
|-------------------|------------|
| Compression ..... | .25 $f'_c$ |
| Tension .....     | .01 $f'_c$ |
| Shear .....       | .02 $f'_c$ |

(e) **Pedestals and Footings (Plain Concrete).** The allowable compressive unit stress on the gross area of a concentrically loaded pedestal shall not exceed  $0.25f'_c$ . Where this stress is exceeded, reinforcement shall be provided and the member designed as a reinforced concrete column.

The depth and width of a pedestal or footing of plain concrete shall be of such that the tension in the concrete shall not exceed  $0.03f'_c$ , and the average shearing stress shall not exceed  $0.02f'_c$  taken on critical sections as determined for reinforced concrete footings. The thickness at the edge shall be not less than eight inches (8") for footings on soil, nor less than fourteen inches (14") above the tops of the piles for footings on piles.

**Sec. 2625. (a) General.** For the purpose of this Chapter all pneumatically placed concrete shall consist of a mixture of fine aggregate and cement pneumatically applied by suitable mechanism, and to which water is added immediately prior to discharge from the applicator.

**Pneumatically  
Placed  
Concrete**

Except as specified in the following Subsections of this Section, all pneumatically placed concrete shall conform to the regulations of this Chapter for concrete.

(b) **Proportions.** The proportion of cement to aggregate, in loose dry volumes, shall be not less than one to four and one-half.

(c) **Water.** The water content at the time of discharge, including any moisture in the fine aggregate, shall not exceed three and one-half gallons per sack of cement.

(d) **Mixing.** The cement and aggregate shall be thoroughly mixed prior to the addition of water. At the time of mixing the fine aggregate shall contain not less than 3 per cent moisture.

(e) **Rebound.** Any rebound or accumulated loose aggregate shall be removed from the surface to be covered prior to

TABLE NO. 26-D—ALLOWABLE SHEAR ON BOLTS

| DIAMETER<br>(Inches) | EMBEDMENT<br>(Inches) | SHEAR<br>(Pounds) |
|----------------------|-----------------------|-------------------|
| $\frac{1}{2}$        | 4                     | 750               |
| $\frac{5}{8}$        | 4                     | 1000              |
| $\frac{3}{4}$        | 5                     | 1500              |
| $\frac{7}{8}$        | 6                     | 2000              |
| 1                    | 7                     | 2500              |
| $1\frac{1}{8}$       | 8                     | 3000              |
| $1\frac{1}{4}$       | 9                     | 3500              |

**Pneumatically  
Placed  
Concrete  
(Cont'd.)**

placing the initial or any succeeding layers of pneumatically placed concrete. Rebound may be re-used if it conforms to the requirements for aggregate, but not in excess of 25 per cent of the total aggregate in any batch.

(f) **Joints.** Unfinished work shall not be allowed to stand for more than 30 minutes unless all abrupt edges are sloped to a thin edge. Before resuming work, this sloped portion shall be cleaned and wetted.

(g) **Damage.** Any pneumatically placed concrete which subsides after placement shall be removed.

**Bolts**

**Sec. 2626.** Bolts shall be solidly embedded in plain or reinforced concrete, and the connection shall be designed so that the shear on every bolt is not more than the values set forth in Table No. 26-D.

## CHAPTER 27—STEEL AND IRON

### (Quality and Design)

**Sec. 2701.** The quality and design of steel and iron used **Quality** structurally in buildings or structures shall conform to the **and** requirements specified in this Chapter, and to the following **Design** standards:

| MATERIALS AND DESIGN                      | U.B.C.<br>DESIGNATION |
|---|-----------------------|
| <b>Structural Steel</b> .....             | <b>27-1</b>           |
| <b>Light Steel for Structural Members</b> |                       |
| Materials .....                           | 27-2                  |
| Design .....                              | 27-3                  |
| <b>Steel Pipe</b> .....                   | 27-4                  |
| <b>Cast Steel</b> .....                   | 27-5                  |
| <b>Cast Iron</b> .....                    | 27-6                  |
| <b>Rivet Steel</b> .....                  | 27-7                  |
| <b>High-Tensile Steel Bolts</b>           |                       |
| (Used in lieu of rivets) .....            | 27-8                  |
| <b>Arc and Gas Welding</b> .....          | 27-9                  |
| <b>Arc-Welding Electrodes</b> .....       | 27-10                 |

Steel pipe for steel pipe columns shall be a medium carbon steel manufactured by the open-hearth or electric-furnace process.

Electrodes shall be of Classified Numbers E6010, E6011, E6012, E6013, E6015, E6016, E6020, or E6030 and shall be suitable for the positions and other conditions of intended use.

All structural steel, cast steel, and cast iron shall be tested in accordance with the above specifications when deemed necessary by the Building Official and copies of such tests shall be filed in the office of the Building Official. No structural steel, cast steel, and cast iron shall be used in any building or structure which does not comply with the above requirements or for which no test results have been filed with the Building Official. All such tests shall be made by competent testing laboratories at the expense of the owner.

The computation and design shall be properly made so that the unit working stresses specified in this Chapter are not exceeded. The structure and its details shall possess the requisite strength and rigidity for proper stability and the design of structural members shall be such as to admit of a rational analysis according to well-established principles of mechanics and sound engineering practice.

All structural steel sections shall be straight and true and any section so damaged as to affect its proper carrying capacity shall not be used in the construction of any building or structure.

**Sec. 2702.** All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds **Allowable Unit Stresses**

**Allowable  
Unit  
Stresses  
(Cont'd.)**

per square inch shall not exceed those specified in this Section.

(a) **Tension**

|   |               |
|---|---------------|
| Structural Steel, net section .....             | 20,000        |
| Cast Steel on net section .....                 | 15,000        |
| Cast Iron on net section .....                  | (not allowed) |
| Rivets, on area based on nominal diameter ..... | 20,000        |
| Bolts, at root of thread .....                  | 20,000        |

(b) **Compression**

Columns, gross section:

For axially loaded columns with values of  $l/r$

$$\text{not greater than } 120 \dots\dots\dots 17,000 - 0.485 \frac{l^2}{r^2}$$

For axially loaded columns (main members)  
with values of  $l/r$

$$\text{greater than } 120 \left[ \frac{18,000}{1 + \frac{l^2}{18,000r^2}} \right] \left[ 1.6 - \frac{l}{200r} \right]$$

For axially loaded columns (bracing and other  
secondary members) with values of  $l/r$

$$\text{greater than } 120 \dots\dots\dots \frac{18,000}{1 + \frac{l^2}{18,000r^2}}$$

Plate Girder Stiffeners, gross section.....20,000

Webs of Rolled Sections at toe of fillet.....24,000

For main compression members, the ratio of  $l/r$  shall not exceed 180 and for bracing, struts, and similar members 200.

On cast-iron columns, with square or fixed ends:

$$P = 9000 - 40 \, l/r$$

with a minimum gross diameter of six inches (6") and with the ratio  $l/r$  never in excess of 70.

In the foregoing formulas  $P$  equals the maximum unit working stress in pounds per square inch;  $l$  equals the unsupported length of the column or compression member in inches; and  $r$  equals the least radius of gyration of the column or compression member.

(c) **Bending.** Tension in extreme fibers of rolled sections, plate girders, and built-up members .....20,000

Compressive unit stress in pounds per square inch in the flange of any member resisting flexure shall not exceed the value computed from the following formula:

$$\text{With } \frac{ld}{bt} \text{ not in excess of } 600 \dots\dots\dots 20,000$$



|   |                 |  |
|---|-----------------|--|
| With $\frac{ld}{bt}$ in excess of 600 ..... | 12,000,000      | Allowable<br>Unit<br>Stresses<br>(Cont'd.) |
|   | $\frac{ld}{bt}$ |  |

in which  $l$  is the laterally unsupported length and  $d$  the depth of the member;  $b$  is the width and  $t$  the thickness of its compression flange, all in inches, except that  $l$  shall be taken as twice the length of the compression flange of a cantilever beam not fully stayed at its outer end against translation or rotation.

Girders, beams, lintels, and similar members may be laterally braced by joists, tie rods, or similar members anchored thereto so as to laterally stay such members in both directions.

On extreme fibers of pins, when the forces are assumed as acting at the center of gravity of the pieces .....30,000

Fully continuous beams and girders may be proportioned for negative moments at the center line of interior points of support, at a unit bending stress 20 per cent\* higher than above stated when these moments are produced by vertical loads; provided that the section modulus used over supports shall be not less than that required for the maximum positive moments in the same beam or girder, and provided that the compression flange shall be regarded as unsupported from the support to the point of contraflexure.

For columns proportioned for combined axial and bending stresses, the maximum unit bending stress  $F_b$  (Section 2703) may be taken at 24,000 pounds per square inch,\* when this stress is induced by the gravity loading of fully or partially restrained beams framing into the columns.

(d) **Shearing**

|  |        |
|--|--------|
| Rivets; pins and turned bolts in reamed or drilled holes ..... | 15,000 |
| Unfinished bolts .....   | 10,000 |
| Webs of beams and plate girders, gross section                 | 13,000 |

(e) **Bearing**

|   | Double<br>Shear | Single<br>Shear |
|---|-----------------|-----------------|
| Rivets; turned bolts in reamed or drilled holes .....           | 40,000          | 32,000          |
| Unfinished bolts .....  | 25,000          | 20,000          |
| Pins .....  | 32,000          |                 |
| Contact Area  |                 |                 |
| Milled stiffeners and other milled surfaces.....                |                 | 30,000          |
| Fitted stiffeners .....   |                 | 27,000          |
| Expansion rollers and rockers<br>(pounds per linear inch) ..... |                 | 600d            |
| in which $d$ is diameter of roller<br>or rocker in inches       |                 |                 |

\*This increase shall not apply in the case of members proportioned for combined lateral and vertical loading at the 33 1/3 per cent stress increase permitted in Section 2303.

**Allowable  
Unit  
Stresses  
(Cont'd.)**

(f) **Reversal of Stress.** The sectional area of the portion between connections, of members subject to reversal of stress, need not be increased by reason of the reversal, but shall be sufficient in area and disposition to provide for the maximum compression, and the maximum tension, separately.

The sectional area of members subject to loads (other than wind loads) producing alternating tensile and compressive stresses shall be augmented, at the approach to a connection, by riveting or welding on additional material, so that the augmented section shall comply with the following rule:

To the net total compressive stress, and to the net total tensile stress, add arithmetically 50 per cent of the smaller of these two; and proportion the connected material and the connecting rivets, bolts, pins, or welds, for each of the two increased stresses thus separately obtained at the unit stresses prescribed in this Section.

(g) **Members Carrying Wind Load Only.** See Section 2303.

(h) **Allowable Unit Stresses for Used Steel.** The allowable unit stresses assigned by the Building Official to any steel not complying with the requirements of Section 2701 shall in no case be more than 80 per cent of the stresses given in Section 2702. In designs where used steel is provided for, proper allowances shall be made for holes, reduction in section by rust, or other defects.

**Eccentric  
Loads**

**Sec. 2703.** Every member and combination of members shall be designed to provide for any stress due to an eccentric load or force, whenever the increase in stress due to eccentric load or force exceeds 10 per cent of the stress due to a direct load or force on the member or members; but a member framed directly to a central web of another member shall not be considered an eccentric load or force in case the resultant of the load or force acts parallel with the said central web.

Rivets, bolts, and welds subject to shearing and externally applied tensile or compressive forces shall be so proportioned that the combined unit stress will not exceed the unit stress allowed for shear.

Members subject to both axial and bending stresses shall be so proportioned that the quantity  $\frac{f_a}{F_a} + \frac{f_b}{F_b}$  shall not exceed unity, in which

$F_a$  = Axial unit stress that would be permitted by this Code if axial stresses only existed.

$F_b$  = Bending unit stress that would be permitted by this Code if bending stresses only existed.

$f_a$  = Unit axial stress (actual) = the total axial stress divided by the area of the member.

$f_b$  = Unit bending stress (actual) = the bending moment divided by the section modulus of the member.

**Beams and  
Girders**

**Sec. 2704. (a) Riveted Plate Girders.** Riveted plate girders, cover-plated beams, and rolled beams shall in general be proportioned by the moment of inertia of the gross section. No deduction shall be made for standard shop or field rivet holes in either flange (except that in special cases where the reduction of the area of either flange by such rivet holes, calculated in accordance with the provisions of Section 2707, exceeds 15 per cent of the gross flange area, the excess shall be deducted). If such members contain other holes, as for bolts, pins, or countersunk rivets, the full deduction for such holes shall be made. The deductions thus applicable to either flange shall be made also for the opposite flange if the corresponding holes are there present. When two or more rolled beams or channels are used to form a girder they shall be so connected to each other as properly to distribute the loads to be carried.

**(b) Plate Girder Webs.** Plate girder webs shall have a thickness of not less than  $1/170$  of the unsupported distance between flanges.

**(c) Web and Flange Splices in Plate Girders.** Web splices in plate girders shall be proportioned to transmit the full shearing and bending stresses in the web at the point of splice.

If the flanges are spliced, the splices shall either develop the full effective strength of the material or they shall develop the strength required by the total stresses, but in no case shall the strength developed be less than 50 per cent of the effective strength of the material spliced, nor shall butt-welded joints be only partially welded.

**(d) Stiffeners.** Stiffeners shall be placed on the webs of plate girders at the ends and at points of concentrated loads. They shall have a close bearing against the flanges, shall extend as closely as possible to the edges of the flange angles, and shall not be crimped. They shall be connected to the web by enough rivets to transmit the stress. Only that portion of the outstanding legs outside the fillets of the flange angles shall be considered effective in bearing.

If  $\frac{h}{t}$  is equal to or greater than 70, intermediate stiffeners shall be required at all points where  $v$  exceeds 64,000,000

$$\left( \frac{h}{t} \right)$$

**WHERE**

$h$  = clear depth between flanges, in inches.

$t$  = thickness of the web, in inches.

$v$  = greatest unit shear in panel, in pounds per square inch under any condition of complete or partial loading.

The clear distance between stiffeners, when stiffeners are

**Beams and  
Girders  
(Cont'd.)**

required by the foregoing, shall not exceed eighty-four inches (84") or that given by the formula:

$$d = \frac{11,000 t}{\sqrt{v}}$$

in which  $d$  equals the clear distance between stiffeners, in inches.

Plate girder stiffeners shall be in pairs, one on each side of the web, and shall be connected to the web by rivets spaced not more than eight times their nominal diameter apart.

Intermediate stiffeners may be crimped over the flange angles.

(e) **Crane Runway Horizontal Forces.** The lateral force on crane runways to provide for the effect of moving crane trolleys shall, if not otherwise specified, be 20 per cent of the sum of the weights of the lifted load and of the crane trolley (but exclusive of other parts of the crane), applied at the top of rail one-half on each side of runway; and shall be considered as acting in either direction normal to the runway rail.

The longitudinal force shall, if not otherwise specified, be taken as 10 per cent of the maximum wheel loads of the crane applied at the top of rail.

(f) **Flange Connections.** Rivets and welds connecting the flanges to the web shall be proportioned to resist the horizontal shear due to bending as well as any loads applied directly to the flange.

(g) **Flanges.** The thickness of outstanding parts of flanges shall conform to the requirements of Section 2705 (b).

Unstiffened cover plates on riveted girders shall not extend more than 16 times the thickness of the thinnest outside plate beyond the outer row of rivets connecting them to the angles. The total cross-sectional area of cover plates of riveted girders shall not exceed 70 per cent of the total flange area.

If the girder is subjected to substantial fluctuations in loading, stiffeners, lateral plates, or other appurtenant material shall not be welded to the tension flange, except at points where the maximum flange stress is less than half the allowable.

(h) **Cover Plates.** Cover plates, when required, shall be of equal thickness or shall diminish in thickness from the flange angles outward. No plate shall be thicker than the flange angles.

(i) **Flange Sections.** The gross section of the compression flange of a plate girder shall be not less than the gross section of the tension flange.

(j) **Rolled Beams.** Rolled beams shall be so proportioned that the unit compression stresses at the web toe of the fillets

resulting from concentrated loads shall not exceed 24,000 pounds. Such stresses shall be determined by the formulas:

**Beams and  
Girders  
(Cont'd.)**

$$\text{For interior loads } \frac{R}{t(N + 2k)} = \text{not over 24,000}$$

$$\text{For end reactions } \frac{R}{t(N + k)} = \text{not over 24,000}$$

**WHERE**

- R = concentrated interior load or end reaction in pounds.  
 t = thickness of web, in inches.  
 N = length of bearing, in inches.  
 k = distance from outer face of flange to web toe of fillet, in inches.

(k) **Effective Span Length.** Beams, girders, and trusses shall ordinarily be designed on the basis of simple spans whose effective length is equal to the distance between centers of gravity of the members to which they deliver their end reactions.

If, on the assumption of end restraint, full or partial, based on continuous or cantilever action, beams, girders, and trusses are designed for a shorter effective span length than that specified in the paragraph above, their sections, as well as the sections of the members to which they connect, shall be designed to carry the shears and moments so introduced, in addition to all other forces, without exceeding at any point the unit stresses specified in Section 2702.

**Sec. 2705. (a) Thickness.** The minimum thicknesses required for protection against crippling, buckling, and shear are as specified in Section 2704. Those stipulations assume that the material is straight and true as erected, within recognized fabricating tolerance limits, and is not reduced by corrosion.

**Limiting  
Dimensions**

No further stipulations as to minimum thickness shall apply to steelwork exposed to conditions no more seriously corroding than an indoor atmosphere controlled for human comfort, subject always to the requirements of Section 2718.

The following stipulations (1) and (2) as to minimum thickness shall apply to exterior steelwork enclosed in a nonimpervious envelope and to interior steelwork subject to atmospheric exposure more corrosive than that mentioned in the preceding paragraph:

1. Columns, studs, lintels, girders, and beams; exterior trusses, exterior bracing members—one-fourth inch ( $\frac{1}{4}$ " ) minimum.

2. Purlins, girts, trusses, and bracing members sheltered from direct exposure to rain—three-sixteenths inch ( $\frac{3}{16}$ " ) minimum.

The controlling thickness of rolled shapes, for the purposes of stipulations (1) and (2), shall be taken as the mean thickness of their flanges, regardless of web thickness.

**Limiting  
Dimensions  
(Cont'd.)**

Steelwork exposed to industrial fumes or vapor shall be given special protection as required.

(b) **Projecting Elements Under Compression.** Projecting elements of members subjected to axial compression or compression due to bending shall have ratios of width to thickness not greater than the following:

|   |    |
|---|----|
| Single-angle struts .....   | 12 |
| Double-angle struts, angles or plates projecting from girders, columns, or other compression members; compression flanges of beams; stiffeners on plate girders; flanges or stems of tees ..... | 16 |

The width of plates shall be taken from the free edge to the first row of rivets or welds; the width of legs of angles, channels, and zeeks, and of the stems of tees, shall be taken as the full nominal dimension; the width of flanges of beams and tees shall be taken as one-half the full nominal width. The thickness of a sloping flange shall be measured halfway between a free edge and the corresponding face of the web.

When a projecting element exceeds the width-to-thickness ratio prescribed in the preceding paragraph, but would conform to same and would satisfy the stress requirements with a portion of its width considered as removed, the member will be considered acceptable without the actual removal of the excess width.

**Compression  
Splices**

**Sec. 2706.** Compression members when faced for bearings shall be spliced sufficiently to hold the connected members accurately in place. Other joints in riveted work, whether in tension or compression, shall be spliced so as to transfer the stress to which the member is subject.

**Gross  
and Net  
Sections**

**Sec. 2707. (a) Riveted Holes.** In computing net area the diameter of a rivet hole shall be taken as one-eighth inch ( $\frac{1}{8}$ " ) greater than the nominal diameter of the rivet.

(b) **Pin Holes.** In pin-connected tension members, the net section across the pin hole, transverse to the axis of the member, shall be not less than 135 per cent and the net section beyond the pin hole, parallel with the axis of the member, not less than 90 per cent, of the net section of the body of the member.

In all pin-connected riveted members the net width across the pin hole, transverse to the axis of the member, shall preferably not exceed eight times the thickness of the member at the pin.

(c) **Chain of Holes.** In the case of a chain of holes extending across a part in any diagonal or zigzag line, the net width of the part shall be obtained by deducting from the gross width the sum of the diameters of all the holes in the chain, and adding to the section so obtained for each gauge

space in the chain, the quantity  $\frac{s^2}{4g}$

WHERE

$s$  = longitudinal pitch of any two successive holes  
 $g$  = transverse gauge of the same two holes.

The critical net section of the part is obtained from the chain which gives the least net width.

**Gross  
and Net  
Sections  
(Cont'd.)**

(d) **Gross Width of Angles.** For angles, the gross width shall be the sum of the widths of the legs less their thickness. The gauge for the holes in opposite legs shall be the sum of the gauges from back of angle less the thickness.

(e) **Splice Members.** For splice members, the thickness shall be only that part of the thickness of the member which has been developed by rivets beyond the section considered.

(f) **Designed Sections.** Unless otherwise specified, tension members shall be designed on the basis of net section. Columns shall be designed on the basis of gross section. Beams and girders shall be designed as specified in Section 2704.

In determining the net section across plug or slot welds, the weld metal shall not be considered as adding to the net area.

**Sec. 2708. (a) Minimum Number of Rivets.** Connections carrying calculated stresses, except for lacing, sag bars, and girts, shall have not fewer than two rivets.

**Connections**

(b) **Eccentricity in Members.** Members meeting at a joint shall have their gravity axis meet at a point if practicable; if not, provision shall be made for their eccentricity.

(c) **Eccentricity in Rivets.** The rivets at the ends of a member transmitting stresses into that member should have their centers of gravity on the line of the center of gravity of the member; if not, provision shall be made for the effect of the resulting eccentricity. Pins may be so placed as to counteract the effect of bending due to dead load.

(d) **Eccentricity in Angles.** Where angles in tension are connected through but one leg and the eccentricity is not taken into account, only 80 per cent of the net section of the angle shall be considered as effective.

(e) **Eccentricity in Members in Flexure.** When beams, girders, or trusses are designed on the basis of simple spans, their end connections may ordinarily be designed for the reaction shears only. If, however, the eccentricity of the connection is excessive, provision shall be made for the resulting moment.

(f) **Combined Shear and Moment.** When beams, girders, or trusses are subject both to reaction shear and end moment, due to full or partial end restraint, based on continuous or cantilever action, their connections shall be especially designed to carry both shear and moment without exceeding at any point the unit stresses specified in Section 2702. Ordinary end connections comprising only a pair of web angles, with not more than nominal seat and top angle, shall not be assumed to provide for this kind of end moment.

(g) **Filler Plates.** When rivets carrying computed stress pass through fillers, the fillers shall be extended beyond the

TABLE NO. 27-A—MINIMUM EDGE-DISTANCES

| RIVET DIAMETER<br>(Inches) | MINIMUM EDGE-DISTANCE (Inches)<br>FOR PUNCHED HOLES |                             |   |
|----------------------------|---|-----------------------------|---|
|                            | In Sheared<br>Edge                                  | In Rolled Edge<br>of Plates | In Rolled Edge of<br>Structural Shapes* |
| $\frac{1}{2}$              | 1   | $\frac{7}{8}$               | $\frac{3}{4}$                           |
| $\frac{5}{8}$              | $1\frac{1}{8}$                                      | 1                           | $\frac{7}{8}$                           |
| $\frac{3}{4}$              | $1\frac{1}{4}$                                      | $1\frac{1}{8}$              | 1                                       |
| $\frac{7}{8}$              | $1\frac{1}{2}$                                      | $1\frac{1}{4}$              | $1\frac{1}{8}$                          |
| 1                          | $1\frac{3}{4}$                                      | $1\frac{1}{2}$              | $1\frac{1}{4}$                          |
| $1\frac{1}{8}$             | 2   | $1\frac{3}{4}$              | $1\frac{1}{2}$                          |
| $1\frac{1}{4}$             | $2\frac{1}{4}$                                      | 2                           | $1\frac{3}{4}$                          |

\*May be decreased  $\frac{1}{8}$  inch when holes are near end of beam.

**Connections  
(Cont'd.)**

connected member and the extension secured by sufficient rivets to develop the strength of the filler.

(h) **Fillers Under Stiffeners.** Fillers under plate girder stiffeners at end bearing or points of concentrated loads shall be secured by sufficient rivets to prevent excessive bending and bearing stresses.

(i) **Riveted Joints.** All joints in riveted work, whether in tension or compression, shall be so spliced as properly to transmit all stresses, except as specified in Section 2706.

The minimum distance from the center of any rivet or bolt hole to any edge shall be as set forth in Table No. 27-A.

The minimum distance between centers of rivet holes shall be three diameters of the rivet.

The maximum pitch in the line of stress of compression members composed of plates and shapes shall not exceed 16 times the thinnest outside plate or shape, or 20 times the thinnest enclosed plate or shape with a maximum of twelve inches (12"); and at right angles to the direction of stress the distance between lines of rivets shall not exceed 32 times the thinnest plate or shape. For angles in built sections with two gauge lines, with rivets staggered, the maximum pitch in the line of stress in each gauge line shall not exceed 24 times the thinnest plate with a maximum of eighteen inches (18").

In tension members composed of two angles, a pitch of three feet six inches (3'6") will be allowed, and in compression members two feet (2'), but the ratio  $l/r$  for each angle between rivets shall be not more than three-fourths of that of the whole member.

The pitch of rivets at the ends of built-up compression members shall not exceed four diameters of the rivets for a length equal to one and one-half times the maximum width of the member.

The minimum distance between the center of any rivet under computed stress, and the end or other boundary of the connected member toward which the pressure of the rivet is directed, shall be not less than the shearing area of the rivet



shank (single or double shear, respectively) divided by the plate thickness. This end distance may, however, be decreased in such proportion as the stress per rivet is less than that specified in Section 2702; and the requirement may be disregarded in case the rivet in question is one of three or more in a line parallel to the direction of the stress.

**Sec. 2709.** In proportioning rivets, the nominal diameter of the rivet shall be used. High-tensile steel bolts may be used in lieu of rivets when conforming with U.B.C. Standard No. 27-8. **Rivets and Bolts**

Rivets carrying calculated stresses, whose grip exceeds five diameters, shall have their number increased one per cent for each additional one-sixteenth inch ( $1/16''$ ) in the rivet grip. Special care shall be used in heating and driving such rivets.

Rivets shall be used for the connections of main members carrying live loads which produce impact, and for connections subject to reversal of stresses.

Unfinished bolts may be used in shop or field work for connections in small structures used for shelters, and for secondary members of all structures such as purlins, girts, door and window framing, alignment bracing, and secondary beams in floor.

The effective bearing area of pins, bolts, and rivets shall be the diameter multiplied by the length in bearing; except that for countersunk rivets, half the depth of the countersink shall be deducted.

Rivets shall be used in the following cases:

1. In all connections in structures over one hundred feet (100') in height when the height is more than two and one-half times the minimum horizontal dimension at the ground line.

2. In all connections in structures one hundred feet (100') or less in height where the height is more than four times the least horizontal dimension at the ground line.

3. In all connections of beams and girders to columns and of beams and girders bracing columns in buildings over one hundred feet (100') in height, and in column splices of buildings more than two hundred feet (200') in height.

4. In all connections for supports of machinery or other moving loads.

Unfinished bolts may be used for connections not mentioned in the preceding paragraphs.

Turned bolts in reamed holes may be used, in place of rivets, in either shop or field work where it is impracticable to obtain satisfactory power-driven rivets, provided holes are as specified in Section 2717. The finished shank shall be long enough to provide a full grip for the nut, and washers shall be used under all nuts.

The end reaction stresses of trusses, girders, or beams, and the axial stresses of tension or compression members

**TABLE NO. 27-B—ALLOWABLE UNIT WORKING STRESSES FOR STATIC LOADS**

|  |                         |
|--|-------------------------|
| Tension in weld metal (butt welds).... | 20,000 lbs. per sq. in. |
| Shear in weld metal .....              | 13,600 lbs. per sq. in. |
| Compression in weld metal .....        | 20,000 lbs. per sq. in. |

which are carried on rivets, shall have such stresses developed by the shearing and bearing values of the rivets or bolts.

#### **Welded Connections**

**Sec. 2710.** Fusion welding may be used (in place of riveting or bolting) for connecting structural steel or wrought-iron parts or members to one another, but in no case shall the stresses in such joints exceed the allowable unit working stresses given in Table No. 27-B.

Maximum fiber stresses due to bending shall not exceed the values prescribed above for tension and compression, respectively. In designing welded joints adequate provision shall be made for bending stresses due to eccentricity, if any, in the disposition or section of base metal parts.

The same proportional increase in the above working stresses shall be allowed for the various given conditions as specified in Section 2702 (f) and (g).

U.B.C. Standard No. 27-9 shall be followed in the design and execution of structural welding.

#### **Construction Details**

**Sec. 2711.** Trusses shall be riveted or welded structures, and only when there is sufficient reason to justify, as where riveted field connections become unwieldy, may they be designed as pin-connected structures.

All joints in riveted work, whether in tension or compression, shall be spliced properly to transmit the stresses.

Bracing shall be sufficient to withstand safely wind and other forces when the building is in the process of erection as well as after completion.

When two or more plates are in contact they shall be stitch riveted with rivets not more than twelve inches (12") apart in either direction.

The ends of beams, channels, girders, and trusses that bear on masonry or reinforced concrete shall be so framed that the allowable stresses for masonry or reinforced concrete shall not be exceeded, and anchors of ample size and strength shall be provided thoroughly embedded in the masonry or reinforced concrete construction.

The ends of all beams, channels, girders, girts, purlins, and similar members that meet on a beam, girder, truss, column, or pier shall be connected to each other by a strap or through the carrying members with not less than two bolts or rivets each not less than five-eighths inch ( $\frac{5}{8}$ " ) in diameter in the end of each connecting member.

Tie rods shall be proportioned to resist their respective stresses, and holes for them shall be placed as near the spring of the arches as practicable.

**Sec. 2712. (a) Compression Members.** The open sides of **Lacing** compression members shall be provided with lacing having tie plates at each end and at intermediate points if the lacing is interrupted. Tie plates shall be as near the ends as practicable. In main members carrying calculated stresses the end tie plates shall have a length of not less than the distance between the lines of rivets connecting them to the flanges, and intermediate ones of not less than one-half of this distance. The thickness of tie plates shall be not less than one-fiftieth of the distance between the lines of rivets connecting them to the segments of the members, and the rivet pitch shall be not more than six diameters and the tie plates shall be connected to each segment by at least three rivets. In welded construction, the welding on each line connecting a tie plate shall aggregate not less than one-third the length of the plate.

**(b) Tension Members.** Tie plates shall be used to secure the parts of tension members composed of shapes. They shall have a length not less than two-thirds of the length specified for tie plates in compression members. The thickness shall be not less than one-fiftieth of the distance between the lines of rivets connecting them to the segments of the member and they shall be connected to each segment by at least three rivets.

**(c) Spacing of Lacing Bars.** Lacing bars of compression members shall be so spaced that the ratio  $l/r$  of the flange included between their connections shall be not over three-fourths of that of the member as a whole.

**(d) Proportioning of Lacing Bars.** Lacing bars shall be proportioned to resist a shearing stress normal to the axis of the member equal to 2 per cent of the total compressive stress of the member. In determining the section required the compression formula shall be used,  $l$  being taken as the length of the bar between the outside rivets connecting it to the segment for single lacing and 70 per cent of that distance for double lacing. The ratio  $l/r$  shall not exceed 140 for single lacing and 200 for double lacing.

**(e) Thickness of Lacing Bars.** The thickness of lacing bars shall be not less than one-fortieth for single lacing and one-sixtieth for double lacing of the distance between end rivets; their minimum width shall be three times the diameter of the rivets connecting them to the segments.

**(f) Inclination of Lacing Bars.** The inclination of lacing bars to the axis of the members shall preferably be not less than 45 degrees for double lacing and 60 degrees for single lacing. When the distance between rivet lines in the flanges is more than fifteen inches (15") the lacing shall be double and riveted at the intersection if bars are used, or else shall be made of angles.

**Sec. 2713.** Pins shall be long enough to insure a full bearing of all parts connected upon the turned-down body of the pin. **Pins and Pin Holes**  
Members packed on pins shall be held against lateral movement.

Pin holes shall be reinforced by plates wherever necessary to give proper bearing. At least one plate shall be as wide as the projecting flanges will allow. Where angles are used this plate shall contain sufficient rivets to distribute their portion of the pin pressure to the full cross section of the member.

**Bearing  
Plates and  
Anchorage**

**Sec. 2714.** Provision shall be made to transfer the column loads to the footings and foundations.

Column bases shall be set level and to correct elevation with full bearing on the masonry.

Column bases shall be finished to accord with the following requirements:

1. Rolled-steel bearing plates two inches (2") or less in thickness may be used without planing or straightening; rolled-steel bearing plates over two inches (2") but less than four inches (4") in thickness may be straightened by pressing, or planed on all bearing surfaces if presses are not available; rolled-steel bearing plates four inches (4") or over in thickness shall be planed on all bearing surfaces (except as noted in paragraph 3 of this Section).

2. Column bases other than rolled-steel bearing plates shall be planed on all bearing surfaces (except as noted in paragraph 3).

3. The bottom surfaces of column bases which rest on masonry foundations and are grouted to insure full bearing contact need not be planed.

4. Anchor bolts shall be of sufficient size and number to develop the computed stresses.

**Light  
Steel  
Construction**

**Sec. 2715. (a) General.** Steel studs, steel joists, and other supports used in the structural frame of light steel construction shall be light-weight rolled sections, or sections made of commonly accepted or specially formed light-gauge flat rolled sheets; or a combination of both used alone or in combination with other materials of construction. Such studs, supports, or steel joists may be of a determinate truss design with elements effectively joined together by arc or resistance welding, or by rivets. In the case of expanded sections, a portion of the metal may be left intact to form a connection. For steel studs the ratio of  $l/r$  shall not exceed 180.

U.B.C. Standard No. 27-3 shall be accepted as recognized engineering practice for the design of light steel structural members, except as otherwise specifically provided in this Code.

Open web or trussed members shall be so constructed that the lines of force of all connected members shall intersect at a point or proper allowance shall be made in the design for any resulting stress. The web elements shall be of sufficient strength to resist effectively the shearing stresses.

The following are the minimum thicknesses of metal permitted for various members of the structural frame of light steel construction:

Bearing studs, floor and roof framing members—16 gauge.

Roof decks supported on ribs—20 gauge.

**Light  
Steel  
Construction  
(Cont'd.)**

All connections shall be riveted, bolted, or welded. All steelwork, including welds and connections, except where entirely encased in concrete, shall be thoroughly cleaned and given one coat of acceptable metal protection well worked into the joints and open spaces.

Steel floor and wall panels shall not be limited by the above thickness requirements, but shall be not less than 18 gauge.

(b) **Stresses.** The unit design stress in structural members of light steel shall not exceed the minimum yield strength of the steel divided by 1.85. For steel conforming to Grade C (minimum yield point 33,000 pounds per square inch) of U.B.C. Standard No. 27-2 the maximum working stress shall not exceed 18,000 pounds per square inch. Steel of higher strength than Grade C shall be suitably identified as to yield point and ultimate strength.

(c) **Construction Details.** Steel studs or other steel supporting members used in the structural frame of light steel construction and steel joists shall be connected to the supporting beams, girders, foundations, or other steel supporting members by arc or resistance welding, riveting, bolting, or other approved methods. All such welds in light steel construction shall be made on two sides or two edges of each bearing in such a manner as to resist effectively the stresses developed. Resistance welding shall develop the full strength of the member welded.

Steel floor and roof members supported on masonry and reinforced concrete shall have end bearings at least four inches (4") in length and the ends of such members resting on masonry or reinforced concrete shall be provided with approved joist anchors thoroughly embedded therein.

Bearing plates, when required by design, shall be securely welded, bolted, or riveted to such floor and roof members, studs, or other supporting members.

Bearing studs or other vertical bearing members shall rest on a sole or plate having an effective width equal to the depth of such member and having a sufficient cross section to transfer the required loads of the vertical member resting thereon unless such bearing vertical member is thoroughly embedded in the concrete foundation. Such soles or plates shall be effectively anchored to the foundation.

When bearing studs or other vertical bearing members are spliced, the full strength of such members shall be developed in the splice.

Where studs do not continue full length from one story through the next story above, a cap plate or steel member shall be provided on top of the lower story studs or a sill plate on the upper story. Such cap plate or sill plate shall

**Light  
Steel  
Construction  
(Cont'd.)**

be of sufficient strength to distribute adequately the loads from the upper story studs to the lower story studs.

All horizontal or diagonal ties or bracing in exterior walls and bearing partitions shall be effectively arc welded, bolted, or riveted to the structural frame or effectively anchored to supporting masonry.

Where plumbing, heating, or other pipes or conduits are placed in or partly in an exterior wall or bearing partition necessitating the cutting of soles or plates, bracing or structural member in said wall, such members shall be reinforced so as to provide sufficient strength to resist the stresses imposed thereon or proper provisions shall be made to transfer such stresses to the points of support.

**Expansion**

**Sec. 2716.** Proper provision shall be made for expansion and contraction.

**Workmanship**

**Sec. 2717.** All workmanship shall be equal to the best practice in modern structural shops.

Drifting to enlarge unfair holes shall not be permitted. Holes that must be enlarged to admit the rivets shall be reamed. Poor matching of holes shall be cause for rejection.

All material shall be clean and straight. If straightening or flattening is necessary, it shall be done by a process that will not injure the material. Sharp kinks or bends shall be cause for rejection.

Rolled sections, except for minor details, shall preferably not be heated, or, if heated shall be annealed.

All steel castings shall be properly annealed.

Material may be punched one-sixteenth inch ( $1/16''$ ) larger than the nominal diameter of the rivets, whenever the thickness of the metal is equal to or less than the diameter of the rivets, plus one-eighth inch ( $1/8''$ ). When the metal is thicker than the diameter of the rivet, plus one-eighth inch ( $1/8''$ ), the holes shall be drilled, or subpunched and reamed.

Holes for shop-turned bolts shall be subpunched and reamed or drilled from the solid. Holes for field-turned bolts shall be subpunched in the shop and reamed in the field.

When subpunching and reaming is required the die used for punching shall be one-sixteenth inch ( $1/16''$ ) smaller than the nominal diameter of the rivet. Rivet holes, after assembling, shall be reamed to a diameter one-sixteenth inch ( $1/16''$ ) greater than the nominal diameter of the rivet. Turned bolt holes, after assembling, shall be reamed (for field bolts in the field) to a diameter one-fiftieth inch ( $1/50''$ ) larger than the diameter of the turned bolt.

Rivets are to be driven hot, and, wherever practicable, by power. Rivet heads shall be of hemispherical shape and uniform in size throughout the work for the same size rivet, full, neatly finished, and concentric with the holes. Rivets, after driving, shall be tight, completely filling the holes, and with heads in full contact with the surface.

Rivets shall be heated uniformly to a temperature not exceeding 1950° F. They shall not be driven after their

temperature is below 1000° F. Loose, burned, and otherwise defective rivets shall be replaced. **Workmanship (Cont'd.)**

Compression joints depending upon contact bearing shall have the bearing surfaces truly faced after the members are riveted. All other joints shall be cut or dressed true and straight.

Finished members shall be true to line and free from twists, bends, and open joints.

Compression members may have a lateral variation not greater than 1/1000 of the axial length between points which are to be laterally supported.

An allowable variation of one thirty-second inch (1/32") is permissible in the over-all length of members with both ends milled.

Members without milled ends which are framed to other steel parts of the structure may have a variation from the detailed length not greater than one-sixteenth inch (1/16") for members thirty feet (30') or less in length, and not greater than one-eighth inch (1/8") for members over thirty feet (30') in length.

Planing or finishing of sheared plates or shapes will not be required unless specifically called for on the drawings.

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting done during assembling shall not distort the metal or enlarge the holes.

Gas cutting may be done under the following conditions:

1. The contractor shall be required to satisfy the Building Official as to his ability to produce satisfactory gas cuts.

2. Gas-cut edges shall be regular in contour.

3. Gas cutting may be used in the preparation of base metal parts for welding, provided the edges so cut are thoroughly cleaned after cutting so as to expose clean metal.

4. Gas cutting shall not be permitted to replace the milling of surfaces specified elsewhere in this Code.

5. Gas cutting shall not be permitted on any member while it is carrying stress. To determine the net area of members so cut, one-eighth inch (1/8") shall be deducted from the gas-cut edges. The radius of re-entrant gas-cut fillets shall be as large as possible, but never less than one inch (1"). This restriction shall not apply to detail cutting for the correction of minor fabricating errors, where the removal of metal resulting from such gas cutting would not reduce the required strength of the member that is to be cut.

6. Gas cutting of holes in any member which has not been designed therefor shall not be permitted.

**Sec. 2718. Parts not in contact, but inaccessible after assembling, shall be properly protected by paint. **Painting****

All steel work, except where entirely encased in concrete, shall be thoroughly cleaned and given one coat of approved metal protection well worked into the joints and open spaces.

Machine-finished surfaces shall be protected against corrosion.

Cast-iron columns shall not be painted until after acceptance by the Building Official.

## PART VII

### DETAILED REGULATIONS

#### CHAPTER 28—EXCAVATIONS, FOUNDATIONS, AND RETAINING WALLS

##### Excavations

**Sec. 2801.** Excavations for buildings and excavations accessory thereto shall be protected and guarded against danger to life and property. Permanent excavations shall have retaining walls of masonry or concrete of sufficient strength to retain the embankment together with any surcharged loads. No excavation for any purpose shall extend within one foot (1') of the angle of repose or natural slope of the soil under any footing or foundation, unless such footing or foundation is first properly underpinned or protected against settlement.

Any person making or causing an excavation to be made to a depth of twelve feet (12') or less, below the grade, shall protect the excavation so that the soil of adjoining property will not cave in or settle, but shall not be liable for the expense of underpinning or extending the foundation of buildings on adjoining properties where his excavation is not in excess of twelve feet (12') in depth. Before commencing the excavation the person making or causing the excavation to be made shall notify in writing the owners of adjoining buildings not less than 10 days before such excavation is to be made that the excavation is to be made and that the adjoining buildings should be protected. The owners of the adjoining properties shall be given access to the excavation for the purpose of protecting such adjoining buildings.

Any person making or causing an excavation to be made exceeding twelve feet (12') in depth below the grade, shall protect the excavation so that the adjoining soil will not cave in or settle, and shall extend the foundation of any adjoining buildings below the depth of twelve feet (12') below grade at his own expense. The owner of the adjoining buildings shall extend the foundations of his buildings to a depth of twelve feet (12') below grade at his own expense as provided in the preceding paragraph.

##### Soil Classification

**Sec. 2802. (a) General.** The classification of the soil under all portions of every building shall be based upon the examination of adequate test borings or excavations made at the site when required by the Building Official. The location of the test borings or excavations and the nature of the subsurface materials shall be indicated on the plans.

**EXCEPTION:** Certain buildings of Type V construction may have footings and foundations designed in accordance with the provisions of Section 2805 and Table No. 28-A.



**TABLE NO. 28-A—MINIMUM FOUNDATION  
REQUIREMENTS FOR STUD BEARING WALLS**

| NUMBER<br>OF<br>STORIES | THICKNESS OF<br>FOUNDATION WALL<br>(Inches) |                 | WIDTH<br>OF<br>FOOTING<br>(Inches) | THICKNESS<br>OF<br>FOOTING<br>(Inches) | DEPTH OF<br>FOUNDATION<br>BELOW<br>NATURAL<br>SURFACE<br>OF GROUND<br>AND FINISH<br>GRADE<br>(Inches) |
|-------------------------|---|-----------------|------------------------------------|--|---|
|                         | Concrete                                    | Unit<br>Masonry |                                    |  |   |
| 1                       | 6   | 6               | 12                                 | 6                                      | 12  |
| 2                       | 8   | 8               | 15                                 | 7                                      | 18  |
| 3                       | 10  | 10              | 18                                 | 8                                      | 24  |

Where unusual conditions or frost conditions are found, footings and foundations shall be as required in Section 2805 (a).

The ground under the floor may be excavated to the elevation of the top of the footing.

(b) **Moisture Content.** Due allowance shall be made in determining the capacity of subsurface materials for the effect of possible change in moisture content.

(c) **Unequal Loads.** Where footings are to be placed at varying elevations the effect of adjacent loads shall be included in the foundation analysis.

**Sec. 2803.** The allowable unit soil pressure upon every footing shall not exceed the values as set forth in Table No. 28-B. **Allowable  
Soil  
Pressures**

**EXCEPTION:** The tabulated values may be modified as prescribed in Section 2804.

**Sec. 2804. (a) Requirements.** Whenever, in the opinion of the Building Official, the adequacy and class of a soil cannot be determined by the test borings or excavations required by the provisions of Section 2802 (a), he may require a special soil investigation before approving the use of the footing. **Soil  
Requirements**

(b) **Deviations.** Deviations from the allowable unit soil pressures set forth in Table No. 28-B shall be permitted only after performance of a special soil investigation by an agency acceptable to the Building Official. The Building Official may approve such deviations only after receiving a written opinion from the investigating agency together with substantiating evidence.

(c) **Stresses.** Where the bearing capacity of the soil is not definitely known or is in question, the Building Official may require load tests or other adequate proof as to the permissible safe bearing capacity at that particular location. To determine the safe bearing capacity of soil it may be tested by loading an area not less than two square feet (2 sq. ft.) to not less than twice the maximum bearing capacity desired for use. Such load shall be sustained by the soil until no

TABLE NO. 28-B—ALLOWABLE SOIL PRESSURE

| CLASS OF MATERIAL  | MINIMUM DEPTH OF<br>FOOTING BELOW<br>ADJACENT VIRGIN<br>GROUND | INCREASE IN VALUE FOR<br>EACH FOOT OF DEPTH<br>THAT FOOTING IS BELOW<br>MINIMUM DEPTH. |      |                 | MAXIMUM<br>VALUE.<br>POUNDS PER<br>SQUARE FOOT |
|--|--|--|------|-----------------|--|
|  |  | VALUE PERMISSIBLE<br>IF FOOTING IS AT<br>MINIMUM DEPTH.<br>POUNDS PER<br>SQUARE FOOT   | 3    | 4               |  |
| 1  | 2  | 3  | 4    | 5               |  |
| Rock   | 0' 0"  | 20% of ultimate<br>crushing strength   | 0    | 20% of ultimate |  |
| Compact coarse sand  | 1' 0"  | 1500*  | 300* | 8000            |  |
| Compact fine sand  | 1' 0"  | 1000*  | 200* | 8000            |  |
| Loose sand   | 2' 0"  | 500*   | 100* | 3000            |  |
| Hard clay or sandy clay  | 1' 0"  | 4000   | 800  | 8000            |  |
| Medium-stiff clay or sandy clay                                | 1' 0"  | 2000   | 200  | 6000            |  |
| Soft sandy clay or clay  | 2' 0"  | 1000   | 50   | 2000            |  |
| Adobe  | 1' 6"  | 1000**   | 50   |                 |  |
| Compact inorganic sand<br>and silt mixtures                    | 1' 0"  | 1000   | 200  | 4000            |  |
| Loose inorganic sand<br>silt mixtures                          | 2' 0"  | 500  | 100  | 1000            |  |
| Loose organic sand<br>and silt mixtures and<br>muck or bay mud | 0' 0"  | 0  | 0    | 0               |  |

\*These values are for footings one foot in width and may be increased in direct proportion to the width of the footing to a maximum of three times the designated value.

\*\*For depths greater than eight feet use values given for clay of comparable consistency.

additional settlement takes place for a period of not less than 48 hours in order that such desired bearing capacity may be used. Examination of subsoil conditions may be required when deemed necessary.

**Sec. 2805. (a) Footings and Foundations.** Footings and foundations, unless specifically provided, shall be constructed of masonry or concrete and shall in all cases extend below the frost line. Footings shall be designed to minimize differential settlement. Mortar used in foundation walls and footings shall be as specified in Section 2403 (s). **Design of Footings**

Bearing walls shall be supported on continuous solid masonry or concrete footings or piles, which shall be of sufficient size to support safely the loads imposed as determined from the character of the soil. Foundation walls supporting wood shall extend at least six inches (6") above the finished grade adjacent to the wall at all points. Mudsills shall be bolted to the foundation or foundation wall with not less than one-half-inch ( $\frac{1}{2}$ ") bolts, embedded at least seven inches (7") into the masonry and spaced not more than six feet (6') apart.

**EXCEPTIONS:** 1. Interior bearing walls in one-story buildings may be supported on piers.

2. For Type V buildings (except Group H and I occupancies), isolated piers of solid masonry or concrete may be used for post and girder construction.

3. A one-story building (except a Group I occupancy) which does not exceed four hundred square feet (400 sq. ft.) in area, including additions, may be constructed without a masonry or concrete foundation if the walls are supported on a wood mudsill.

Mudsills shall be no wood other than Foundation Grade redwood, Foundation Grade cedar, all heartwood cypress, or any species of wood pressure-treated with an approved preservative, all marked or branded by an approved agency.

Minimum foundation requirements for stud bearing walls shall be as set forth in Table No. 28-A.

Foundations for all buildings where the surface of the ground slopes more than one foot (1') in ten feet (10') shall be level or shall be stepped so that both top and bottom of such foundation are level.

**(b) Structural Design.** Except for special provisions of Section 2807, covering the design of piles, all portions of footings shall be designed in accordance with the structural provisions of this Code.

**Sec. 2806.** When grillage footings of structural steel shapes are used on soils, they shall be completely embedded in concrete with at least six inches (6") on the bottom and at least four inches (4") at all other points. **Grillage Footings**

**Sec. 2807. (a) General.** The allowable axial and lateral loads on piles shall be determined by an approved formula, **Piles**

**Piles**  
**(Cont'd.)**

by load tests, or by a foundation investigation by an approved agency. A foundation investigation shall be made if required by the Building Official.

(b) **Allowable Loads.** 1. **Axial loads.** The allowable axial load on a pile shall not exceed the value given by the following formulas unless such load is otherwise determined as specified in Section 2804.

Allowable Axial Load =  $R/4$  for all piles.

WHERE

$$R \text{ (for steel piles)} = \frac{12 Wh \frac{W + 0.25P}{W + P}}{S + \frac{RL 24,000}{AE}}$$

$$R \text{ (for other piles)} = \frac{12 Wh \frac{W + 0.1P}{W + P}}{S + \frac{RL 24,000}{AE}}$$

WHERE

- R = ultimate driving resistance, in tons.
- W = weight of striking parts, in tons.
- h = height of fall of striking parts, in feet.
- Wh = striking energy, in foot tons.
- P = weight of pile, in tons.
- S = permanent settlement of pile under the average of the last 10 blows, in inches.
- L = length of pile, in feet.
- A = average right cross-sectional area of pile material, in square inches.
- E = modulus of elasticity of pile, in pounds per square inch.

2. **Group action.** Consideration shall be given to the reduction of allowable pile load when piles are placed in groups. Where soil conditions make such load reductions advisable or necessary, the allowable axial load determined for a single pile shall be reduced by any rational method or formula approved by the Building Official.

3. **Static load tests.** When the allowable axial load of a single pile is determined by load test, one of the following methods shall be used:

**Method 1.** It shall not exceed 50 per cent of the yield point under test load. The yield point shall be defined as that point at which an increase in load produces a disproportionate increase in settlement.

**Method 2.** It shall not exceed one-half of the load which causes a net settlement, after deducting rebound, of one

one-hundredth inch (.01") per ton of test load, which has been applied for a period of at least 24 hours. **Piles (Cont'd.)**

**Method 3.** It shall not exceed one-half of that load under which, during a 40-hour period of continuous load application, no additional settlement takes place.

**4. Column action.** All piles standing unbraced in air, water, or material not capable of lateral support, shall conform with the applicable column formula as specified in this Code. Such piles driven into firm ground may be considered fixed and laterally supported at five feet (5') below the ground surface and in soft material at ten feet (10') below the ground surface unless otherwise prescribed by the Building Official after a foundation investigation by an approved agency.

**5. Piles in subsiding areas.** Where piles are driven through subsiding fills or other subsiding strata and derive support from underlying firmer materials, consideration shall be given to the downward frictional forces which may be imposed on the piles by the subsiding upper strata.

**(c) Protection of Pile Materials.** Where the boring records of site conditions indicate possible deleterious action on pile materials because of soil constituents, changing water levels, or other factors, such materials shall be adequately protected by methods or processes approved by the Building Official. The effectiveness of such methods or processes for the particular purpose shall have been thoroughly established by satisfactory service records or other evidence which demonstrates the effectiveness of such protective measures.

**(d) Structural Strength of Piles and Limiting Values of Stresses.** The allowable compressive stresses on all piling materials shall not exceed the values as specified below, except that stresses may be increased on submission of satisfactory data for specially protected, selected, or high-strength material.

1. Concrete—.225%.

2. Structural steel—9000 pounds per square inch.

3. Wood—The allowable stress in compression parallel to the grain of round wood piles shall not exceed 60 per cent of the basic stress for clear material as set forth in U.B.C. Standard No. 25-3 and in no event shall the stress exceed 1000 pounds per square inch.

4. Reinforcing steel—as in Chapter 26.

The full load shall be assumed as carried on the pile cross section located at the upper surface of the soil supporting the pile.

Where the influence of subsiding fills is considered as imposing loads on the pile, the above stresses may be increased if satisfactory substantiating data are submitted.

**(e) Round Wood Piles. 1. Quality.** Every wood pile shall

**Piles  
(Cont'd.)**

conform to the specification for Class A or Class B piles in U.B.C. Standard No. 28-1.

**2. Treated piles.** Creosoted piles of Douglas fir or of Southern pine shall be treated with Grade 1 creosote in accordance with U.B.C. Standard No. 28-2 with final retention of not less than 12 pounds per cubic foot for Douglas fir nor less than 15 pounds per cubic foot for Southern pine.

**(f) Precast Concrete Piles. 1. Quality.** Precast concrete piles shall be cast in one piece and prior to driving and at 28 days after pouring shall develop an ultimate compressive strength ( $f'_c$ ) of at least 3000 pounds per square inch.

**2. Reinforcement ties.** The longitudinal reinforcement in driven precast concrete piles shall be laterally tied with steel ties or wire spirals. Ties and spirals shall be spaced not more than three inches (3") apart, center to center, for a distance of two feet (2') from the ends and not more than eight inches (8") elsewhere.

**3. Diameter.** The diameter of ties and spirals shall be as follows:

For piles having a diameter of sixteen inches (16") or less, wire shall be not smaller than No. 5 gauge.

For piles having a diameter of more than sixteen inches (16") and less than twenty inches (20"), wire shall be not smaller than No. 4 gauge.

For piles having a diameter twenty inches (20") and larger, wire shall be not smaller than one-fourth-inch ( $\frac{1}{4}$ ") round or No. 3 gauge.

**4. Stresses.** Precast concrete piling shall be designed to resist stresses induced by handling and driving as well as by loads.

**(g) Uncased Cast-in-Place Friction Piles. 1. Quality.** Concrete piles cast in place against earth in drilled or bored holes shall be made in such a manner as to insure the exclusion of any foreign matter and to secure a full-sized shaft. The length of such pile shall be limited to not more than 30 times the average diameter. Concrete shall have an ultimate compressive strength ( $f'_c$ ) of not less than 2500 pounds per square inch.

**2. Friction.** Any uncased cast-in-place pile may be assumed to develop a frictional resistance equal to one-sixth of the bearing value of the soil material at minimum depth as set forth in Table No. 28-B but not to exceed 500 pounds per square foot unless a greater value is prescribed by the Building Official after a soil investigation as specified in Section 2804.

**3. Combined friction and bearing prohibited.** Frictional resistance and bearing resistance shall not be assumed to act simultaneously.

**(h) Metal-Cased Concrete Piles. 1. Dimensions.** Every metal casing for a concrete pile shall have a sealed tip with a diameter of not less than eight inches (8").

**Piles  
(Cont'd.)**

Concrete piles cast in place in metal shells shall have shells driven for their full length in contact with the surrounding soil and left permanently in place. The shells shall be sufficiently strong to resist collapse and sufficiently watertight to exclude water and foreign material during the placing of the concrete.

2. **Concrete.** All concrete used in metal-cased concrete piles shall have an ultimate compressive strength ( $f'_c$ ) of not less than 2500 pounds per square inch.

3. **Order of driving.** Piles shall be driven in such order and with such spacing as to insure against distortion of or injury to piles already in place. No pile shall be driven within four and one-half average pile diameters of a pile filled with concrete less than 24 hours old unless approved by the Building Official.

(i) **Concrete-Filled Steel Pipe Piles.** 1. **Steel pipe.** Steel pipe piles shall conform to U.B.C. Standard No. 28-3. If it is desired to use pipe of other material, satisfactory substantiating data must be submitted.

2. **Concrete.** The concrete used in concrete-filled steel pipe piles shall have an ultimate compressive strength ( $f'_c$ ) of not less than 2500 pounds per square inch.

3. **Allowable loads.** The allowable load on concrete-filled steel pipe piles shall not exceed 9000 pounds per square inch on the steel plus .225 of the ultimate compressive strength ( $f'_c$ ) of the concrete.

(j) **Rolled Structural Steel Piles.** Structural steel piles shall conform to U.B.C. Standard No. 27-1.

No section shall have a nominal thickness of metal less than three-eighths inch ( $\frac{3}{8}$ " ).

(k) **Jetting.** Jetting shall not be used except where and as specifically permitted by the Building Official. When used, jetting shall be carried out in such a manner that the carrying capacity of existing piles and structures shall not be impaired. After withdrawal of the jet, piles shall be driven down until the required resistance is obtained.

(l) **Special Piles or Special Conditions.** The use of types of piles not specifically mentioned herein, and the use of piles under conditions not specifically covered herein, shall be permitted, subject to the approval of the Building Official, upon submission of acceptable test data, calculations, or other information relating to the properties and load-carrying capacity of such piles.

**CHAPTER 29—VENEERED WALLS****General**

**Sec. 2901. (a) Limitations.** Veneer shall not be assumed to add to the strength of any wall.

(b) **Height.** Exterior veneer shall not be attached to wood at any point more than twenty feet (20') above the adjacent ground elevation.

(c) **Horizontal Forces.** Veneer shall not be assumed to resist horizontal forces, except as specifically provided in Section 2902.

(d) **Exceptions.** The limitations in this Chapter shall not apply to interior veneer of units five-eighths inch ( $\frac{5}{8}$ " ) or less in thickness.

**Veneer of  
Masonry  
Units**

**Sec. 2902. (a) Scope.** The provisions of this Section shall apply to all veneer which is constructed of masonry conforming to the requirements of Chapter 24.

(b) **Vertical Loads.** No veneer shall support any vertical load other than the dead load of the veneer above. Veneer above openings shall be supported upon lintels of incombustible material.

(c) **Anchorage.** Masonry veneer shall be attached to the supporting wall with corrosion-resistant metal ties, or other approved method, designed to resist a horizontal force equal to twice the weight of the attached veneer.

Veneer ties, if strand wire, shall be not less in thickness than No. 6 W. & M. gauge wire and shall have a hook embedded in the mortar joint, or if sheet metal, not less than 22 U.S. gauge corrugated. Each tie shall support not more than two square feet (2 sq. ft.) of wall area and shall be spaced not more than twenty-four inches (24") on center horizontally.

In lieu of such wire ties, an approved method of grouting the veneer to a paper-backed reinforcement attached direct to the studs may be used.

(d) **Support.** The weight of masonry veneer shall be supported upon footings or other incombustible structural supports spaced not over twelve feet (12') vertically above a point twenty feet (20') above the adjacent ground elevation.

**EXCEPTION:** The weight of masonry veneer attached to wood frame walls shall be supported entirely upon footings.

**Veneer  
of Non-  
Structural  
Units**

**Sec. 2903. (a) Scope.** The provisions of this Section shall apply to all veneer of materials not regulated by the requirements of Chapter 24.

(b) **Loads and Stresses.** For the purpose of this Section,



veneer of non-structural units shall not be assumed to support any superimposed loads.

**Veneer  
of Non-  
Structural  
Units  
(Cont'd.)**

(c) **Anchorage.** Non-structural material used as veneer shall be anchored to the supporting wall by corrosion-resistant metal ties not less in thickness than No. 9 W. & M. gauge wire, and spaced not more than twelve inches (12") apart both horizontally and vertically.

**EXCEPTION:** Approved units, or units of flat tile, stone, or terra cotta which are manufactured with scored surface may be cemented to a masonry or concrete wall or to exterior plaster with Type A portland cement mortar, provided the mortar bond is sufficient to withstand a shearing stress of 50 pounds per square inch after curing for 28 days.

**Sec. 2904. (a) General.** In addition to the general requirements of this Chapter, all veneer of glass shall comply with the regulations in this Section.

**Special  
Requirements  
for Glass  
Veneer**

Glass veneer shall not be attached to any exterior wall at a point more than thirty-five feet (35') above the adjoining ground elevation.

(b) **Dimension.** Glass-veneer units shall be not less than one-eighth inch ( $\frac{1}{8}$ " ) in thickness. Units less than three-sixteenths inch ( $\frac{3}{16}$ " ) in thickness shall be not larger in area than one square foot (1 sq. ft.). Units not more than one-fourth inch ( $\frac{1}{4}$ " ) nor less than three-sixteenths inch ( $\frac{3}{16}$ " ) in thickness shall be not larger in area than four square feet (4 sq. ft.).

No unit shall be larger in area than ten square feet (10 sq. ft.) or more than four feet (4') in length.

(c) **Attachment.** Every glass-veneer unit shall be attached to the backing by approved corrosion-resistant ties and shall be supported upon shelf angles.

**EXCEPTIONS:** 1. Below a point twenty-two feet (22') above the adjacent ground elevations, the ties may be omitted.

2. Below a point three feet (3') above the adjacent ground elevations, the ties and shelf angles may be omitted.

(d) **Mastic.** The mastic shall cover not less than one-half of the area of the unit after the unit has been set in place and shall be neither less than one-fourth inch ( $\frac{1}{4}$ " ) nor more than one-half inch ( $\frac{1}{2}$ " ) in thickness.

The mastic shall be insoluble in water and shall not lose its adhesive qualities when dry.

Absorbent surfaces shall be sealed by a bonding coat before mastic is applied. The bonding coat shall be cohesive with the mastic.

Glass-veneer surfaces to which mastic is applied shall be clean and uncoated.

**Special  
Requirements  
for Glass  
Veneer  
(Cont'd.)**

(e) **Shelf Angles.** Shelf angles shall be of corrosion-resistant material capable of supporting four times the weight of the supported veneer.

The shelf angles shall be spaced vertically in alternate horizontal joints but not more than three feet (3') apart.

The shelf angles shall be spaced not farther apart horizontally than the width of the supported units.

(f) **Backing.** Exterior glass veneer shall be applied only upon masonry, concrete, or exterior plaster.

(g) **Expansion Joints.** Glass-veneer units shall be separated from each other and from adjoining materials by an expansion joint at least one thirty-second inch ( $1/32''$ ) in thickness. There shall be at least one sixty-fourth-inch ( $1/64''$ ) clearance between bolts and the adjacent glass.

## CHAPTER 30—ENCLOSURE OF VERTICAL OPENINGS

**Sec. 3001.** Vertical openings are required to be enclosed as set forth in Table No. 17-A. For enclosures of stairways and ramps see Chapter 33.

**Enclosures:  
When  
Required**

**Sec. 3002.** Walls and partitions enclosing elevators shall be of not less than the fire-resistive construction required under Types of Construction in Part V. Enclosing walls of elevator shafts may consist of wire glass set in metal frames on the entrance side only. Elevator shafts extending through more than two stories shall be equipped with an approved means of adequate ventilation to and through the main roof of the building.

**Elevator  
Enclosures**

**Sec. 3003.** All shafts, ducts, chutes, and other vertical openings not covered in Section 3002 shall have enclosing walls conforming to the requirements specified under Type of Construction of the building in which they are located.

**Other  
Vertical  
Openings**

**Sec. 3004.** Air ducts passing through a floor shall be enclosed in a shaft. The shaft shall be as required for vertical openings in Part V. Dampers shall be installed where ducts pierce the shaft enclosure walls. Dampers shall conform to U.B.C. Standard No. 30-1. Air ducts in Group I occupancies need not be enclosed in a shaft if conforming to Chapter 51. (See Appendix.)

**Air Ducts**

**CHAPTER 31—FLOOR CONSTRUCTION****General**

**Sec. 3101.** Floor construction shall be of materials and construction as specified under Occupancy in Part III and under Types of Construction in Part V.

All floors shall be so framed and tied into the framework and supporting walls as to form an integral part of the whole building.

The types of floor construction used shall provide means to keep the beams and girders from spreading by installing either ties or bridging, with no laterally unsupported length of joists being permitted to exceed eight feet (8') except as otherwise specified in Sections 3102 and 3103.

Fire-resistive standards of floor construction are specified in Section 4305.

**Concrete Floors**

**Sec. 3102.** Concrete slab floors shall be not less than two inches (2") thick. Topping when poured monolithic with the slab may be included as a structural part of the slab. Sleepers for the nailing of a wood floor shall not decrease the required structural depth of the slab unless placed in the direction of span and then shall not be placed more than one-half inch ( $\frac{1}{2}$ ") into the slab.

**Steel-Joisted Floors**

**Sec. 3103.** Steel-joisted floors shall consist of steel joists as specified in Section 2715. When used in Type I or Type II buildings they shall have a reinforced concrete or gypsum slab not less than two inches (2") thick placed on and secured to the top thereof, and a fire-resistive ceiling as specified in Section 4305, on the under side thereof, fully covering and protecting the joists; provided that when such joists are used in places where unprotected wood joists are permitted the steel joists need not be protected with fire-resistive materials as specified above.

The reinforced concrete or gypsum slab placed on and secured to the top of the steel joists shall be sufficiently reinforced to support all dead, live, or other loads between joists. Joists shall be securely cross bridged at intervals not to exceed eight feet (8') along the joist length.

Bridging shall be provided during the period of construction to support adequately the top chord or flange against lateral movement and such bridging shall be designed to hold each joist in a vertical plane. Sufficient permanent bridging shall be installed to stay the joists laterally and to transmit any horizontal forces in either direction perpendicular to the direction of the joists. Such bridging shall consist of solid concrete sections, structural steel shapes or plates, portal bridging, diagonal rods, or other bridging which will provide equal stiffness. Any row of bridging shall be capable of transferring 500 pounds from each joist to the adjoining joists.

**Cellular Steel Floors**

**Sec. 3104. (a) General.** Cellular steel floor construction shall consist of sheet or strip steel formed into an inte-

grated system of parallel steel beams which combine the function of load-bearing members and a continuous deck spanning between main supporting girders, beams, or walls.

**Cellular  
Steel Floors  
(Cont'd.)**

When used in fire-resistive construction, steel floors shall have a minimum of two inches (2") of concrete fill on top and shall be protected with a fire-resistive ceiling suspended from the underside.

(b) **Physical Properties.** The steel used in the manufacture of steel floor units shall be equal to the requirements of U.B.C. Standard No. 27-2.

(c) **Minimum Thickness.** The thickness of the steel used in the manufacture of steel floors shall be not less than U. S. Standard gauge No. 18.

(d) **Design.** Cellular steel floors shall admit of a rational analysis, and such floor assemblies shall have been tested and certified by a recognized testing agency to substantiate stress values used.

Flexural stress values shall not exceed 60 per cent of the yield point specified for the grade steel permitted in Subsection (b).

When plastered ceilings are suspended from steel subfloor units, the maximum permissible deflection due to the full live load after the plaster is applied shall not exceed 1/360 of the span.

**Sec. 3105.** Wood-joisted floors shall be framed and constructed and anchored to supporting wood stud or masonry walls as specified in Chapter 25. Wood-joisted floors need not be fire-protected on the underside except where specifically required under Occupancy in Part III, Location in Part IV, or Types of Construction in Part V.

**Wood  
Floors**

In wood frame floor construction where suspended ceilings occur, the space between the ceiling and the floor above shall be divided into areas not exceeding one thousand square feet (1000 sq. ft.) in a manner required for partitioning attic space in Section 3205.

An eighteen-inch by twenty-four-inch (18" x 24") access crawl hole shall be provided to under floor space.

## CHAPTER 32—ROOF CONSTRUCTION AND COVERING

### General

**Sec. 3201.** Roof covering shall be as required under Occupancy in Part III, Location in Part IV, or Types of Construction in Part V. All roofs shall be so framed and tied into framework and supporting walls as to form an integral part of the whole building.

### Construction

**Sec. 3202.** The general requirements for construction of floors as specified in Chapter 31 shall apply to roofs, except that concrete or gypsum roof slabs shall be not less than two inches (2") in thickness.

Roof trusses shall have all joints well fitted and shall have all tension members well tightened before any load is placed on the truss. Diagonal and sway bracing shall be used to brace all roof trusses. The allowable working stresses of materials in trusses shall be as specified in Chapters 25 and 27. The minimum net section of the members after framing shall be used in determining the strength of the truss at any point.

Plywood roof sheathing, unless of exterior type, shall have no surface or edge exposed to weather and shall be of minimum thicknesses set forth in Table No. 25-M.

### Roof Coverings

**Sec. 3203. (a) General.** Roof coverings for all buildings shall be either "fire-retardant" or "ordinary" roof coverings as specifically required either by Location in Part IV or by Types of Construction in Part V. The roof covering shall be securely fastened to the supporting roof construction.

**(b) Composition Roofing Materials.** For purposes of this Section, certain terms are designated as follows:

**FELT**, roofing felt made from organic or asbestos fibers saturated with bituminous compound.

**CAP SHEET**, roofing made of organic or asbestos fibers saturated and coated on both sides with a bituminous compound and surfaced with mineral granules, mica, talc, ilmenite, asbestos fibers, or similar materials, except on the unexposed portions of split cap sheets.

**CEMENTING MATERIAL**, built-up composition roof thoroughly mopped solid between layers with bituminous compound using not less than 20 pounds of hot asphalt or not less than one and one-half gallons of cold bituminous compound in accordance with roofing manufacturer's published specifications or hot coal tar pitch, using 30 pounds per one hundred square feet (100 sq. ft.) of roof area.

**SPOT CEMENTING**, intermittent application of asphalt sealing agent in an amount not less than 10 pounds per one hundred square feet (100 sq. ft.) of roof area at points not more than twelve inches (12") apart.

**BASE SHEETS**, one or more layers of saturated felt or saturated and coated roofing products over which is placed

a cap sheet, asbestos shingles, composition shingles, gravel surfacing, ceramic, or other similar surfacing materials.

**Roof  
Coverings  
(Cont'd.)**

(c) **Materials.** All materials shall be delivered in original packages bearing manufacturer's label. Mineral-surfaced cap sheets, asphalt shingles, and smooth-surface cap sheets shall bear the label of the Underwriters' Laboratories, Inc., for Class A, B, or C roofing.

Nails for composition roof shall be not smaller than 12 gauge, with heads not less than three-eighths inch ( $\frac{3}{8}$ " ) in diameter for shingle application and nine-sixteenths inch ( $\frac{9}{16}$ " ) for built-up roofs and shall be long enough fully to penetrate the sheathing to a maximum three-fourths inch ( $\frac{3}{4}$ " ). Smaller head nails may be substituted providing metal discs are used with them. Exposed nails and shingle nails shall be corrosion resistant.

(d) **Application.** Base sheets shall be nailed to the roof sheathing using not less than one nail to each one and one-third square feet ( $1\frac{1}{3}$  sq. ft.) of roof area, or base sheets may be spot cemented to an existing composition roof, or spot cemented or fully mopped to a suitable deck.

Asphalt shingles shall be nailed according to manufacturer's printed specifications, but for strip shingles of square tab type, weighing approximately 210 pounds per square and measuring twelve inches by thirty-six inches (12" x 36" ), no less than six nails shall be used per each strip.

Hot asphalt shall be applied at a temperature of not less than 375 degrees Fahrenheit and shall in no case be heated to a temperature higher than 425 degrees Fahrenheit at the kettle.

Coal tar pitch shall not be heated above 375 degrees Fahrenheit.

(e) **Fire-Retardant Roof Coverings.** A fire-retardant roof covering shall be any roof covering which meets the requirements specified for any one of the following roofings, 1 to 7 inclusive, or shall be any roof assembly bearing the label of the Underwriters' Laboratories, Inc., for Class A or B roofing.

1. Any built-up composition roofing consisting of materials whose fire-retardant values as set forth in Table No. 32-A equal not less than 15 points including a top covering selected from parts (b), (c), or (d) of said table.

2. Hydraulic compressed rigid shingles not less than one-eighth inch ( $\frac{1}{8}$ " ) thick, composed of portland cement and asbestos fibers, laid over a layer of saturated felt weighing not less than 14 pounds to one hundred square feet (100 sq. ft.), or hydraulic compressed rigid sheets not less than seven thirty-seconds inch ( $\frac{7}{32}$ " ) thick, composed of portland cement and asbestos fibers. The aforesaid felt may be omitted when the compressed shingles are placed over an existing roof covering.

3. Asphalt-saturated mineral-surfaced prepared composition shingles laid so there are not less than two thicknesses

TABLE NO. 32-A—FIRE-RETARDANT VALUES OF ROOFING MATERIALS

|  | SHIPPING<br>WEIGHT<br>(Pounds) | TYPES OF MATERIALS   | MIN. WT.<br>PER 100<br>SQ. FT. OF<br>ROOF AREA<br>(Pounds) | FIRE-<br>RETARDANT<br>VALUE |
|--|--------------------------------|--|--|-----------------------------|
|  |                                |  |  |                             |
| (a) BASE SHEETS ONLY   | 15                             | Asphalt-Saturated Felt.....                                | 14   | 3                           |
|  | 30                             | Asphalt-Saturated Felt.....                                | 28   | 6                           |
|  | 20                             | Asphalt-Saturated and Coated Dampcourse.....               | 18   | 4                           |
|  | 40                             | Asphalt-Smooth Surfaced Roofing.....                       | 37   | 6                           |
|  | 15                             | Asphalt-Saturated Asbestos Felt.....                       | 14   | 5                           |
|  | 20                             | Asphalt-Saturated Asbestos Felt.....                       | 18   | 5                           |
| (b) BASE OR CAP SHEETS   | 45                             | Asphalt-Saturated Asbestos Felt<br>(Black Top).....        | 41   | 9                           |
|  | 55                             | Asphalt-Saturated Asbestos Felt<br>(Black Top).....        | 50   | 10                          |
|  | 15                             | Asphalt-Saturated Asbestos Felt<br>(minimum 2 layers)..... | 28   | 10                          |
|  |                                |  |  |                             |
| (c) CAP SHEETS ONLY  | 55                             | Mineral-Surfaced Split Sheets<br>(minimum 2 layers).....   | 106  | 12                          |
|  | 58                             | Ilmenite-Surfaced Split Sheets<br>(minimum 2 layers).....  | 106  | 12                          |
|  | 58                             | Ilmenite-Surfaced Roofing.....                             | 55   | 7                           |
|  | 90                             | Mineral-Surfaced Asphalt Cap Sheet.....                    | 83   | 10                          |
|  | 75                             | Smooth-Surfaced Cap Sheet.....                             | 68   | 9                           |
|  | 65                             | Smooth-Surfaced Cap Sheet.....                             | 60   | 7                           |
|  | 55                             | Smooth-Surfaced Cap Sheet.....                             | 50   | 6                           |
|  | 39                             | Asphalt-Saturated Asbestos Roofing<br>(White Top).....     | 37   | 9                           |
|  | 55                             | Asphalt-Saturated Asbestos Roofing<br>(White Top).....     | 52   | 10                          |
|  |                                |  |  |                             |
| (d) GRAVEL, CERAMIC,<br>AND OTHER SIMILAR<br>SURFACING MATERIALS |                                | Gravel $\frac{1}{4}$ " to $\frac{1}{2}$ " in size.....     | 400  | 6                           |
|  |                                | Slag $\frac{1}{4}$ " to $\frac{1}{2}$ " in size.....       | 300  | 6                           |
|  |                                | Ceramics and other surfacing materials                     | { 300  | 4                           |
|  |                                | $\frac{1}{8}$ " to $\frac{1}{2}$ " in size.....            | { 400  | 6                           |



at any point. The combined weight of such shingles shall be not less than 200 pounds to one hundred square feet (100 sq. ft.) of completed roof area.

**Roof  
Coverings  
(Cont'd.)**

4. Concrete slab or concrete tile roofs, constructed as specified in Chapter 26 without additional roof covering.

5. Metal roof covering of corrugated, standing seam or flat type of not less than No. 30 U. S. gauge metal. All flat metal roof coverings shall be laid on solid sheathing. Corrugated or standing seam metal roof covering shall be designed to support the required live load between supporting members.

6. Slate shingles securely fastened with copper nails or with copper nails and No. 14 B. & S. gauge copper wire, with nails of such lengths as to provide not less than three-fourths inch ( $\frac{3}{4}$ " ) of penetration into the nailing strips or sheathing. Under all such shingles there shall be placed at least one layer of asphalt-saturated felt weighing not less than 30 pounds to one hundred eight square feet (108 sq. ft.).

7. Clay roof tile securely fastened with copper nails or copper wire; provided that for roofs not exceeding a rise of eight inches (8") in twelve inches (12"), galvanized iron nails may be used, and provided further that tile with projection lugs need not be nailed or wired in place. Wire shall be not smaller than No. 14 B. & S. gauge. Nails shall penetrate the supporting roof construction not less than three-fourths inch ( $\frac{3}{4}$ " ).

Roofing tile other than flat pan tile with or without flanges, or flat shingle tile, or flat decorative tile, shall satisfy the following strength requirements: When supported on the turned-down edges at points six inches (6") each side of the center of the tile, giving four points of support and a span of twelve inches (12") and loaded with a concentration at the center, the average breaking load per tile for five representative tile tested shall be not less than 400 pounds and the breaking load for any individual tile tested shall be not less than 350 pounds.

Roof tile shall not absorb more than 15 per cent of the dry weight of the tile during a 48-hour immersion test.

Under all burned clay units, there shall be placed not less than two layers of asphalt-saturated rag felt, each layer weighing not less than 14 pounds to one hundred square feet (100 sq. ft.), solidly mopped between and surfaced with asphalt.

(f) **Ordinary Roofings.** "Ordinary" roofing shall be any roof covering which meets the requirements specified for the following roofings:

1. Any composition roofing or any built-up composition roofing consisting of layers of roofing felt, roll roofing, felt membrane, or gravel, the sum of whose fire-retardant values as set forth in Table No. 32-A equals not less than 10;

**TABLE NO. 32-B—WOOD SHINGLE ROOF COVERING—  
MAXIMUM EXPOSURE TO WEATHER**

| PITCH OF ROOF      |     | SHINGLE LENGTH |         |         |
|--------------------|-----|----------------|---------|---------|
| Rise               | Run | 16-inch        | 18-inch | 24-inch |
| 3" to less than 4" | 12" | 3¾"            | 4¼"     | 5¾"     |
| 4" to less than 5" | 12" | 4½"            | 5¼"     | 7"      |
| 5" or more         | 12" | 5"             | 5½"     | 7½"     |

**Roof  
Coverings  
(Cont'd.)**

2. Asphalt shingles laid in one or more layers; or shall be any roofing meeting the Class C specifications of the Underwriters' Laboratories, Inc.

(g) **Wood Shingles.** All wood shingles for roofs shall conform to U.B.C. Standard No. 32-1, and shall bear the label of an approved inspection bureau or agency guaranteeing compliance with U.B.C. Standard No. 32-1.

All wood shingles shall be laid with a side lap of at least one and one-half inches (1½") in adjacent courses, and three-fourths inch (¾") in alternate courses with at least two courses of solid wood protecting each side joint.

Every wood shingle shall be laid not less than one-eighth inch (⅛") or more than three-eighths inch (⅜") from any adjacent shingle, and shall be nailed to the sheathing with two 14-gauge hot-dipped galvanized, zinc, cadmium plated, aluminum, or copper nails penetrating into the sheathing at least three-fourths inch (¾").

The exposure to the weather of wood shingle roofs shall not exceed the amount set forth in Table No. 32-B.

Shingles shall not be installed on a roof having a pitch less than four inches (4") to twelve inches (12"), unless provided with an underlay.

(h) **Roofings for Group J Occupancies.** On buildings housing Group J, Division 1 occupancies, any composition roofing having a fire-retardant value equal to not less than six, as set forth in Table No. 32-A, may be used, unless otherwise required because of location as specified in Parts IV and V of this Code.

**Roof  
Insulation**

**Sec. 3204.** The use of cork, fiberboard, and other combustible roof insulation shall be permitted in all types of construction provided it is covered with approved roof coverings applied directly thereto.

**Attics:  
Access and  
Areas**

**Sec. 3205.** All buildings shall have access provided to the attic space by means of a stairway or permanent ladder or a scuttle. The openings provided through the ceiling for such access into the attic space shall be not less than twenty-two inches by thirty inches (22" x 30") and shall be located in the hallway or corridor of all Type III and V buildings three stories or more in height.

Type III or V buildings, one or two stories in height, shall have scuttle holes into the attic space which are not less than eighteen inches (18") square.

In wood frame roof construction where ceilings occur the attic spaces or spaces between ceilings and the underside of roofs shall be divided into horizontal areas of not more than twenty-five hundred square feet (2500 sq. ft.) with tight one-inch (1") partitions of matched wood, one-half inch ( $\frac{1}{2}$ ") thick exterior type plywood, or approved incombustible materials. All openings through these partitions shall be protected by self-closing doors of the same thickness and materials as the partition.

**Attics:  
Access and  
Areas  
(Cont'd.)**

**EXCEPTION:** Where the attic is fully equipped with an automatic fire-extinguishing system the divided horizontal area may be tripled.

Draft stops shall be installed in trussed roofs, between roof and bottom chord of trusses, in all buildings exceeding twenty thousand square feet (20,000 sq. ft.) of floor area. Such draft stops shall divide the under roof area into sections not to exceed twenty thousand square feet (20,000 sq. ft.).

**Sec. 3206.** The water from the roof of all buildings which would flow by gravity over a public sidewalk shall be carried by means of conductors under the sidewalk and through the curb into the gutter. Overflows shall be installed at each low point of the roof to which the water drains. Concealed roof drainage pipe shall be installed as required for soil, waste, or vent piping.

**Roof  
Drainage**

**EXCEPTION:** Buildings of Group I or J occupancies, the walls of which are ten feet (10') or more from the street property line, need not comply with the above.

## CHAPTER 33—STAIRS, EXITS, AND OCCUPANT LOADS

### General

**Sec. 3301. (a) Purpose.** The purpose of this Chapter is to determine occupant loads and to provide minimum standards of egress facilities for occupants of buildings.

**(b) Scope.** Every building shall be provided with exits as required by this Chapter. Where there is conflict between a general requirement and a specific requirement for an individual occupancy, the specific requirement shall be applicable.

**(c) Definitions.** "Occupant load" is the total number of persons actually occupying a building or portion thereof at any one time, but shall never be assumed to be less than the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A for the occupancy housed therein. When the square feet per occupant is not given for a particular occupancy it shall be determined by the Building Official, based on the area given for the occupancy which it most nearly resembles.

"Panic hardware" is a bar which extends across at least half the width of each door leaf, or is a floor plate below the full width of each door opening; either of which will open the door if subjected to pressure.

**(d) Room Capacity.** The occupant load of a room or building shall be the actual number of seats but not less than

**TABLE NO. 33-A—AVAILABLE SQUARE FEET  
PER OCCUPANT**

| OCCUPANCY                              | SQUARE FEET<br>PER<br>OCCUPANT |
|--|--------------------------------|
| Assembly Areas                         | 7                              |
| Classrooms                             | 20                             |
| Dance Floors                           | 7                              |
| Dining Rooms                           | 15                             |
| Dwellings (Group I)                    | 300                            |
| Gymnasiums                             | 15                             |
| Homes for Children and Aged            | 50                             |
| Hospitals and Sanitariums              | 100                            |
| Hotels and Apartments                  | 200                            |
| Parking Garages (Open)                 | 200                            |
| Sales—Retail                           |                                |
| Basement                               | 20                             |
| First Floor                            | 30                             |
| Upper Floors                           | 50                             |
| School Shops and Vocational Rooms      | 50                             |
| Skating Rinks                          | 15                             |
| Storage Garages and Storage Warehouses | 300                            |
| All Others                             | 100                            |

the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A. **General (Cont'd.)**

(e) **Benches.** Where benches or pews are used the number of seats shall be based on one person for each eighteen inches (18") of length of the pews or benches.

(f) **Mixed Occupancies.** The capacity of a building containing mixed occupancies shall be determined by adding the number of occupants of the various portions as set forth in Table No. 33-A.

(g) **More Than One Occupancy.** The capacity of a room or building which is used for different occupancies at different times shall be determined by the occupant load which gives the largest number of persons.

(h) **Exit Obstruction.** No obstruction shall be placed in the required width of an exit.

(i) **Room Capacity Posted.** The maximum room capacity shall be conspicuously posted by the owner of the building by means of durable metal signs placed in each assembly room, auditorium, or room used for a similar purpose where fixed seats are not installed, and it shall be unlawful to remove or deface such notice or to permit more than this legal number of persons within such space.

(j) **Changes in Elevation.** Changes in elevation of less than twelve inches (12"), along any means of egress within a building, shall be by means of ramps, except for occupant loads of less than 10.

**Sec. 3302. (a) Number of Persons.** The number of persons permitted in any building or portion thereof shall not exceed those set forth in Table No. 33-A, except that where additional exit facilities are provided the occupancy load may be increased in accordance with Section 3302 (b) and (c). **Exits Required**

(b) **Number of Exits.** Buildings, or portions thereof, having an occupant load of more than 10 shall have not less than two exits.

Buildings, or portions thereof, having an occupant load of 500 to 999 shall have not less than three exits.

Buildings, or portions thereof, having an occupant load of 1000 or more shall have not less than four exits.

Floors above the first floor, and basements or cellars used for other than service of the building, shall have not less than two exits.

**EXCEPTION:** Only one exit need be provided for an upper floor in a Group I occupancy or from a second floor or mezzanine having an area of not more than five hundred square feet (500 sq. ft.) in a Group F or G occupancy.

(c) **Width.** The total width of exits in feet shall be not less than the total occupant load served divided by 50. Such width of exits shall be divided approximately equally among separate exits.

The width of exits from any story of a building shall be

**Exits  
Required  
(Cont'd.)**

determined from the occupant load in that story plus one-half the tributary occupant load in the story next above or below, provided the resulting width is not less than that required for the upper story considered separately. The maximum exit width required for any story shall be maintained until egress is provided from the structure.

(d) **Arrangement of Exits.** If only two exits are required they shall be placed a distance apart equal to not less than one-fifth of the perimeter of the room. Where three or more exits are required they shall be arranged a reasonable distance apart so that if one becomes blocked others will be available.

In a building not equipped with an automatic fire-extinguishing system, no point shall be more than one hundred fifty feet (150') from an exterior exit, a horizontal exit, or an enclosed stairway, measured along the line of travel.

In a building of Type I or Type II construction, or where the building is equipped with a complete automatic fire-extinguishing system, the above distance from exits may be increased to two hundred feet (200').

**Doors**

**Sec. 3303. (a) General.** This Section shall apply to every exit door serving an occupant load of more than 10, and serving hazardous rooms or areas, except as set forth in Subsection (d).

(b) **Swing.** Exit doors shall swing in the direction of exit travel when serving any hazardous area and when serving an occupant load of 50 or more. Plate glass doors shall have a center bar, or shall be sufficiently decorated to make door plainly visible.

(c) **Operation.** Exit doors shall be openable from the inside without the use of key or any special knowledge or effort.

(d) **Width.** The required width of a door opening shall not be reduced more than three inches (3") by any projections.

No required doorway shall be less than thirty-six inches (36") in width.

**EXCEPTION:** Exit doors serving areas housing one or more bedridden patients shall be not less than three feet six inches (3'6") in width.

(e) **Door Leaf Width.** No leaf of an exit door shall exceed four feet (4') in width.

(f) **Special Doors.** Revolving, vertical sliding, and overhead rolling doors shall not be used unless exit doors of required width are installed adjacent thereto.

(g) **Egress from Door.** Every door shall open into a corridor, enclosed stairway, exterior stairway where permitted as a required exit, exterior exit court, or public way.

(h) **Doors Opening into Stairway.** Every door opening into a stairway shall open on a landing within two inches (2") of the floor level. The width of the landing shall not be reduced more than six inches (6") by the door when fully open. See Section 3305 (d).

**Sec. 3304. (a) General.** This Section shall apply to every **Corridors** corridor serving as a required exit for an occupant load of more than 10.

(b) **Width.** Every required corridor shall be not less in width than forty-four inches (44").

**EXCEPTION:** Regardless of the exemption in Subsection (a), corridors serving any area housing a bedridden patient, other than in Group I occupancies, shall be not less than eight feet (8') in width.

(c) **Projections.** The required width of corridors shall be unobstructed.

**EXCEPTIONS:** 1. Trim and handrails may project three and one-half inches (3½").

2. Doors, when fully open, may project six inches (6").

(d) **Access to Exits.** Floors above the first floor shall have exits so arranged that it is possible to go in either direction from any point in a corridor to a stairway.

(e) **Walls.** Corridor walls and ceilings shall be of not less than one-hour fire-resistive construction.

**EXCEPTIONS:** 1. One-story buildings housing Group F and G occupancies.

2. In Group C occupancies and in buildings more than one story in height containing either Group G occupancies or office areas of Group F occupancies, the heat transmission limit on the unexposed side of the corridor wall shall not exceed 600 degrees Fahrenheit above room temperature when tested in accordance with the requirements set forth in U.B.C. Standard No. 43-1.

(f) **Corridor Dead End.** There shall be no dead end in any corridor or hall more than twelve feet (12') beyond the exit stair or door.

(g) **Openings.** Where corridor walls are required to be one-hour fire-resistive, doors shall be Class "C" or steel or a one and three-eighths inch (1⅜") solid-core wood door, and other interior openings shall be of one-fourth-inch (¼") wire glass set in steel frames. Openings, other than doors, shall not exceed 25 per cent of the area of the corridor walls.

**Sec. 3305. (a) Width.** Stairways serving an occupant load **Stairs** of more than 50 shall be not less in width than forty-four inches (44").

Stairways serving an occupant load of 50 or less may be thirty-six inches (36") wide.

Stairways serving an occupant load of 10 or less may be thirty inches (30") wide.

Trim and handrails may project three and one-half inches (3½") into the required width of any stairway.

(b) **Rise and Run.** The rise of every step in a stairway shall not exceed seven and one-half inches (7½"), and the run shall be not less than ten inches (10").

Except as provided under Subsection (c), the maximum

**Stairs**  
**(Cont'd.)**

variations in the height of risers and in the width of treads in any one flight shall be three-sixteenths inch (3/16").

**EXCEPTION:** In stairways serving an occupant load of 50 or less or serving temporary reviewing stands, the rise may be eight inches (8") and the run may be nine inches (9").

(c) **Windings.** In Group I occupancies and in monumental unrequired stairways, windings may be used if the required width of run is provided at a point not more than twelve inches (12") from the side of the stairway where the treads are the narrower, but in no case shall any width of run be less than six inches (6") at any point.

(d) **Landings.** Every landing shall have a dimension measured in the direction of travel equal to the width of the stairway, but such dimension need not exceed four feet (4').

In Group A, B, and C occupancies the walls at the outer corners of landings shall be curved on a radius of at least two feet (2'), or a 45-degree splay not less than twenty inches (20") wide shall be provided to eliminate right-angle corners.

(e) **Basement Stairways.** Where a basement stairway and a stairway to an upper story terminate in the same vestibule or other space, the basement stairway shall be cut off by a one-hour fire-resistive partition and a self-closing Class "B" fire door.

(f) **Distance Between Landings.** There shall be not more than twelve feet (12') vertically between landings.

(g) **Handrails.** Stairways shall have handrails on each side, and every stairway more than eighty-eight inches (88") in width shall have intermediate handrails dividing the stairway into portions not more than sixty-six inches (66") in width.

Handrails shall be placed not less than thirty inches (30") nor more than thirty-four inches (34") above the nosing of treads, and ends of handrails shall be returned to the wall.

**EXCEPTIONS:** 1. Stairways forty-two inches (42") or less in width may have one handrail.

2. Handrails shall not be required for exterior monumental stairways.

(h) **Exterior Stairways.** Every opening in the exterior wall of a building served by an exterior stairway used as a required exit shall be protected by an automatically closing Class "E" or "F" fire door or window if the opening is within twenty feet (20') of the stairway.

**EXCEPTION:** Openings above or level with the highest portion of the stairway may be unprotected if not nearer than ten feet (10') to the stairway.

(i) **Stairway Construction—Interior.** Interior stairways shall be constructed as specified in Part V of this Code. Stairs serving as egress from corridors which are required to be one-hour fire-resistive construction in Section 3304 (e),



shall have walls and soffits of one-hour fire-resistive construction. Where there is enclosed usable space under stairways of wood or unprotected metal, the soffits of the stairs shall be protected as required for one-hour fire-resistive construction.

**Stairs  
(Cont'd.)**

(j) **Stairway Construction—Exterior.** Exterior stairs shall be of incombustible material except that on buildings not exceeding two stories in height they may be of wood not less than two inches (2") in nominal thickness.

(k) **Stairway to Roof.** In every building more than two stories in height, one stairway shall extend to the roof surface unless the roof has a slope greater than four in twelve.

(l) **Headroom.** Every required stairway shall have headroom clearance of not less than six feet six inches (6'6") measured vertically from the nearest nosing to the nearest soffit.

**Sec. 3306. (a) General.** A ramp conforming to the requirements of this Section may be used as an exit.

**Ramps**

(b) **Width.** The width of ramps shall be as required for corridors.

(c) **Slope.** The slope of a ramp shall not exceed one in eight.

(d) **Handrails.** A ramp with slope exceeding one in ten shall have handrails as required for stairways.

(e) **Construction.** Ramps shall be constructed as required for stairways.

(f) **Surface.** The surface of ramps shall be roughened or shall be of non-slip material.

**Sec. 3307. (a) Definition.** A "horizontal exit" is a horizontal passageway or ramp into another building or into another section of the same building through a "One-Hour Fire-Resistive Occupancy Separation."

**Horizontal  
Exits**

(b) **Used as a Required Exit.** If conforming to the provisions of this Chapter, a horizontal exit may be considered as a required exit.

(c) **Discharge Areas.** A horizontal exit shall lead into a floor area having capacity for an occupant load not less than the occupant load served by such exit. The capacity shall be determined by allowing three square feet (3 sq. ft.) of net clear floor area per occupant. The area into which the horizontal exit leads shall be provided with exits as required by Section 3302, at least one of which shall lead directly to a public way.

**Sec. 3308. (a) General.** Every interior stairway, ramp, or escalator shall be enclosed as specified in this Section.

**Exit  
Enclosures**

**EXCEPTIONS:** 1. In occupancies other than Group D, an enclosure will not be required for a stairway, ramp, or

**Exit  
Enclosures  
(Cont'd.)**

escalator serving only the second floor and not connected with corridors or stairways serving floors above the second floor.

2. In buildings of Type I construction housing Group F and G occupancies, and equipped with automatic fire-extinguishing systems, enclosures are not required for escalators.

3. Stairs in Group I occupancies need not be enclosed.

(b) **Enclosure Construction.** Enclosure walls shall be of not less than two-hour fire-resistive construction in buildings more than four stories in height and shall be of not less than one-hour fire-resistive construction elsewhere.

(c) **Openings into Enclosures.** There shall be no openings into exit enclosures except exit doorways and openings in exterior walls. Every exit door in an exit enclosure shall be a self-closing Class "B" fire door. Every opening in an exterior wall forming part of an exit enclosure shall be protected by a Class "E" or "F" fire door or window unless opening into a public way at least sixteen feet (16') wide.

(d) **Extent of Enclosure.** Stairway and ramp enclosures shall include landings and parts of floors connecting stairway flights and shall also include a corridor on the ground floor leading from the stairway to the exterior of the building. Enclosed corridors or passageways are not required from unenclosed stairways.

**Smokeproof  
Enclosures**

**Sec. 3309. (a) General.** A smokeproof enclosure shall consist of a continuous stairway enclosed from the highest point to the lowest point by walls of two-hour fire-resistive construction. The supporting structural frame shall be of four-hour fire-resistive construction.

(b) **Where Required.** In buildings five stories or more in height, one of the required exits shall be a smokeproof enclosure.

(c) **Construction.** Stairs in smokeproof enclosures shall be of incombustible construction.

(d) **Access.** There shall be no opening directly into the interior of the building. Access shall be through a vestibule open to the outside having an exit door from the interior of the building and an exit door leading to the smokeproof enclosure. In lieu of a vestibule, access may be by way of an exterior open balcony of incombustible materials.

(e) **Doors.** Exit doors to smokeproof enclosures shall be self-closing Class "B" fire doors.

(f) **Outlet.** A smokeproof enclosure shall exit into a public way or into a passageway leading to a public way. The passageway shall be without other openings and shall have walls of two-hour fire resistance and floors and ceilings of two-hour fire resistance.

(g) **Barrier.** A smokeproof enclosure stair shall not continue below the grade level exit unless a barrier is provided at the ground floor level to prevent persons from continuing on into the basement.

**Sec. 3310.** Every exit shall discharge into a public way or exit court. **Exit Outlets**

**Sec. 3311. (a) Discharge.** Every exit court shall discharge into a public way or passageway leading to a public way. The passageway shall be without other openings and shall have walls, floors, and ceilings of the same period of fire resistance as the walls, ceilings, and floors of the building but shall be not less than one-hour fire-resistive construction. **Exit Courts**

(b) **Width.** Every exit court shall be not less in width than the required total width of the tributary exits.

(c) **Slope.** The slope of exit courts shall not exceed one in ten.

(d) **Openings.** Openings between a Group A and B occupancy and an exit court less than sixteen feet (16') wide shall be protected by Class "E" or "F" fire doors or windows.

**EXCEPTION:** Openings more than twenty feet (20') above the floor of the exit court may be unprotected.

(e) **Obstructions.** The required width of exit courts shall be unobstructed except for trim and handrails which may project not more than three and one-half inches (3½") into the required width.

At any point where the width of an exit court is reduced from any cause, the reduction in width shall be effected gradually by a guard rail at least three feet (3') high. The guard rail shall make an angle of not more than 30 degrees with the axis of the exit court.

**Sec. 3312. (a) Exit Illumination.** Exits shall be illuminated at all times with light having an intensity of not less than one foot candle at floor level. **Exit Signs and Illumination**

(b) **Exit Signs.** At every exit doorway, and wherever otherwise required to clearly indicate the direction of egress, an exit sign with letters at least five inches (5") high shall be provided from all areas serving the occupant load specified in this Subsection. In interior stairways the floor level leading direct to the exterior shall be clearly indicated.

1. Group B, C, D, and H occupancies with an occupant load of more than 50.

2. All other occupancies serving an occupant load of more than 100.

(c) **Illumination of Signs.** Exit signs shall be lighted in the following occupancies with two electric lamps of not less than 15 watts each in the manner specified in this Subsection:

**Exit Signs  
and  
Illumination  
(Con't.)**

1. Two separate sources of supply shall be required for Group A occupancies and Divisions 1 and 2 of Group B except buildings with occupant loads of less than 750 persons, used as churches, lodge rooms, recreation halls, and gymnasiums.

2. Separate circuits, one of which shall be separate from all other circuits in the building, shall be required for the following occupancies:

- (1) Group A, B, and C occupancies with an occupant load over 300 persons and not otherwise regulated in this Subsection.
- (2) Group D and H occupancies with an occupant load over 100 persons.
- (3) Group F occupancies with an occupant load over 1000 persons.

**Aisles**

**Sec. 3313. (a) General.** Every portion of every building in which are installed seats, tables, or equipment shall be provided with aisles leading to an exit.

(b) **Width.** Every aisle shall be not less than three feet (3') wide if having seats on only one side, and not less than three feet six inches (3' 6") wide if having seats on both sides. Such minimum width shall be measured at the end farthest from the foyer and shall be increased by one and one-half inches (1½") for each five feet (5') in length toward the foyer.

**EXCEPTION:** In Group B, Division 4 occupancies, aisles need not be over three feet six inches (3' 6") wide.

(c) **Distances to Nearest Exit.** In areas occupied by seats, and in Group A and B occupancies without seats, the line of travel to an exit door by an aisle shall be not more than one hundred and fifty feet (150').

(d) **Aisle Spacing.** Aisles shall be located so that there will be not more than six intervening seats between any seat and the nearest aisle.

**EXCEPTION:** There may be 20 intervening seats between any seat and the nearest aisle in Group B, Division 4 occupancies.

(e) **Cross Aisles.** When aisles terminate in a cross aisle instead of a foyer, the width of the cross aisle shall be not less than the sum of the width of the widest aisle plus 50 per cent of the total width of the remaining aisles leading thereto.

(f) **Vomitories.** Vomitories connecting the main exit with the cross aisles shall have a total width not less than the sum of the width of the widest aisle leading thereto plus 50 per cent of the total width of the remaining aisles leading thereto.

(g) **Slope.** The slope of aisles shall not exceed one-foot (1') fall in eight feet (8').

**Sec. 3314. (a) Spacing.** The spacing of rows of seats from **Seats** back to back shall be not less than thirty-three inches (33"), nor less than twenty-seven inches (27") plus the sum of the thickness of the back and inclination of the back.

**EXCEPTION:** In Group B, Division 4 occupancies, the spacing of rows of seats without backs may be twenty-two inches (22").

**(b) Width.** The width of any seat shall be not less than eighteen inches (18").

**Sec. 3315.** Rollaway, telescoping, and fold-up bleacher **Bleacher** seats without backs shall conform to the requirements of **Seats** this Section.

Bleacher sections shall contain not more than 20 rows of seats.

Spacing of seats back to back shall be not less than twenty-two inches (22").

Bleacher sections shall be provided with aisles.

**EXCEPTION:** Bleachers with not more than 11 rows of seats need not be provided with aisles if the vertical distance between seats does not exceed twelve inches (12").

Aisles shall be not less than three feet six inches (3'6") in width.

There shall be not more than nine seats between any seat and an aisle.

The width of cross aisles and aisles to exitways shall be as specified in Section 3313.

Where bleacher sections are placed on platforms above the main floor, a cross aisle and guard railing shall be provided at the front of such sections.

Open end sections shall be provided with railings for that portion above the fourth row of seats. Where the back of a bleacher section is not placed against a wall, a railing shall be provided at the back of the section.

Any increase of occupant load because of the addition of bleachers shall require additional exit facilities.

**Sec. 3316. (a) Main Exit.** Every Group A occupancy shall be provided with a main exit.

**Exits:  
Group A  
Occupancies**

The main exit shall be of sufficient width to accommodate one-half the total occupant load but shall be not less than the total width of all aisles and stairways leading thereto and shall connect to a stairway or ramp leading to a public way.

Steps may be used if separated from the main exit by a landing not less in area than the foyer.

**(b) Side Exits.** Every auditorium and balcony of a Group A occupancy shall be provided with exits on each side. The exits on each side of the auditorium or balcony shall be of sufficient width to accommodate one-third of the total occupant load served. Side exits shall open directly into an exit court or a ramp leading to an exit court, except that side

exits from a balcony may lead to a stairway, and side exits from balconies above the first balcony shall be by way of a stairway or ramp in a smokeproof enclosure. Side exits shall be accessible from a cross aisle or a side aisle.

(c) **Panic Hardware.** An exit door from a Group A occupancy having an occupant load of more than 50 shall not be provided with a latch or lock unless it is panic hardware.

**Exits:  
Group B  
Occupancies**

**Sec. 3317. (a) Group B, Divisions 1 and 2.** Divisions 1 and 2 occupancies shall have exits as required by Section 3316.

(b) **Group B, Divisions 3 and 4.** An exit door from any Group B occupancy, Divisions 3 and 4, having an occupant load of more than 50, shall not be provided with a latch or lock unless it is panic hardware.

**Exits:  
Group C  
Occupancies**

**Sec. 3318. (a) Corridors.** The width of a corridor in a Group C occupancy shall be the width required by Section 3302 plus two feet (2'), but no corridor shall be less than six feet (6') wide.

Corridor walls and ceilings shall be of not less than one-hour fire-resistive construction. For exceptions, see Section 3304(e)2.

There shall be no change of elevation of less than two feet (2') in a corridor unless ramps are used.

(b) **Corridors Serving Auditoriums.** An exit serving both an auditorium and other rooms need provide only for the capacity of whichever requires the greater width if the auditorium is not to be used simultaneously with the other rooms.

(c) **Stairs.** Each floor above or below the ground floor level shall have not less than two exit stairs and the required exit width shall be equally divided between such stairs, provided that no stair serving an occupant load of more than 100 shall be less than five feet (5') in width exclusive of rails.

**EXCEPTION:** This Subsection does not apply to rooms used for maintenance, storage, and similar purposes.

(d) **Doors.** The width of exit doors from corridors, halls, and stairs shall be not more than two feet (2') narrower than the required width of such corridors, halls, or stairs.

Exit doors in schoolrooms shall swing in the direction of egress.

(e) **Exterior Exit.** Any room, the floor of which is below grade and which is used by pupils, shall have at least one exit leading directly to the exterior of the building, and such exit shall be not less in width than one-half the required aggregate width of exits from such room.

(f) **Self-Releasing Device.** Exit doors from rooms having an occupant load of more than 100 and from corridors shall not be provided with a latch or lock unless it is panic hardware.

**Sec. 3319. (a) Separate Exits.** Every room in a Group D occupancy shall have access to two separate exits.

**Exits:  
Group D  
Occupancies**

(b) **Corridors.** There shall be no change of elevation of less than two feet (2') in a corridor unless ramps are used.

(c) **Basement Exits.** One exit from every room below grade shall be to the exterior.

(d) **Ramps.** Every portion of a Group D occupancy, Division 2, in buildings of Types II, III, IV, and V housing bedridden patients, shall have access to a horizontal exit or a ramp leading to the exterior.

(e) **Locks.** No exterior door shall be lockable from the inside, except in sanitariums for mental patients.

(f) **Places of Detention.** No requirements of this Chapter shall be so construed as to prohibit the construction of cell blocks in jails or prevent the use of any locks or safety devices in buildings conforming to the provisions of this Code where it is necessary forcibly to restrain the inmates.

(g) **Exceptions.** Where construction meets the requirements of Section 902 (b), the exterior doors may be fastened with locks, provided that room doors shall not be fastened by other means than doorknobs or similar devices which can be opened readily from the corridor side without the use of keys.

**Sec. 3320.** Every portion of a Group E occupancy having a floor area of two hundred square feet (200 sq. ft.) or more shall be served by at least two separate exits.

**Exits:  
Group E  
Occupancies**

**Sec. 3321. (a) Boiler Rooms.** Every boiler room and every room, except in Group I occupancies, containing an oil-fired furnace or incinerator shall be provided with at least two means of exit, one of which may be a ladder.

**Special  
Hazards**

(b) **Cellulose Nitrate Handling.** Film laboratories, projection rooms, and nitrocellulose processing rooms shall have not less than two exits.

**CHAPTER 34—SKYLIGHTS****Skylights**

**Sec. 3401.** Except for Group I and J occupancies all skylights shall be constructed with metal frames. Frames of skylights shall be designed to carry loads required for roofs as specified in Section 2305. All skylights, the glass of which is set at an angle of less than 45 degrees from the horizontal, if located above the first story, shall be set at least one foot (1') above the roof. The curbs on which the skylight rests shall be constructed as required for inner court walls or for masonry.

Spacing between supports for flat wired glass in skylights shall not exceed twenty-five inches (25"). Corrugated wired glass may have supports five feet (5') apart in the direction of the corrugation. All glass in skylights shall be wire glass, except that skylights over vertical shafts extending through two or more stories shall be glazed with plain glass as specified in this Section; provided, that wire glass may be used if ventilation equal to not less than one-eighth the cross-sectional area of the shaft but never less than four feet (4') is provided at the top of such shaft.

Any glass not wire glass shall be protected above and below with a screen constructed of wire not smaller than No. 12 B. & S. gauge with a mesh not larger than one inch (1"). The screen shall be substantially supported below the glass.

Skylights installed for the use of photographers may be constructed of metal frames and plate glass without wire netting.

Ordinary glass may be used in the roofs and skylights for greenhouses, provided the height of the greenhouse at the ridge does not exceed twenty feet (20') above the grade. The use of wood in the frames of skylights will be permitted in greenhouses outside of Fire Zones Nos. 1 and 2, if the height of the skylight does not exceed twenty feet (20') above the grade, but in other cases metal frames and metal sash bars shall be used.

Glass used for the transmission of light, if placed in floors or sidewalks, shall be supported by metal or reinforced concrete frames, and such glass shall be not less than one-half inch ( $\frac{1}{2}$ ") in thickness. Any such glass over sixteen square inches (16 sq. in.) in area, shall have wire mesh embedded in the same or shall be provided with a wire screen underneath as specified for skylights in this Section. All portions of the floor lights or sidewalk lights shall be of the same strength as is required by this Code for floor or sidewalk construction, except in cases where the floor is surrounded by a railing not less than three feet six inches (3'6") in height, in which case the construction shall be calculated for not less than roof loads.



## CHAPTER 35—BAYS, PORCHES, AND BALCONIES

Sec. 3501. Construction of walls and floors in bay and oriel windows shall conform to the construction allowed for exterior walls and floors of the type of construction of the building to which they are attached. The roof covering of a bay or oriel window shall conform to the requirements for roofing of the main roof of the building.

**Bay and  
Oriel  
Windows**

Sec. 3502. Exterior balconies attached to or supported by walls required to be of masonry shall have brackets or beams constructed of incombustible material. Railings for balconies or porches shall be not less than three feet (3') in height above the floor of such balcony or porch.

**Balconies  
and Porches**

Porches and exterior balconies may be constructed of the materials allowed for the building to which they are attached, but structural steel or iron members need not be fire protected.

## CHAPTER 36—PENTHOUSES AND ROOF STRUCTURES

### Penthouses and Roof Structures

**Sec. 3601.** No penthouse or other projection above the roof in structures of other than Type I construction shall exceed twenty-eight feet (28') in height above the roof when used as an enclosure for tanks or for elevators which run to the roof and in all other cases shall not extend more than twelve feet (12') in height above the roof. The aggregate area of all penthouses and other roof structures shall not exceed 20 per cent of the area of the supporting roof. No penthouse, bulkhead, or any other similar projection above the roof shall be used for manufacturing or storage.

Roof structures of Type I and II buildings shall be constructed with walls, floors, and roof as required for the main portion of the building.

**EXCEPTION:** Exterior walls and roofs of penthouses which are five feet (5') or more from an adjacent property line may be of one-hour fire-resistive construction.

In all groups, structures parallel to and within five feet (5') of the exterior walls of Type III buildings shall be constructed the same as the exterior walls of the story immediately below. Walls other than those occurring within five feet (5') of an exterior wall of a Type III building shall be of not less than one-hour fire-resistive construction. The restrictions of this paragraph shall not prohibit the placing of wood flagpoles or similar structures on the roof of any building.

### Towers and Spires

**Sec. 3602.** Towers or spires when enclosed shall have exterior walls as required for the building to which they are attached. Towers not enclosed and which extend more than seventy-five feet (75') above grade shall have their framework constructed of iron, steel, or reinforced concrete. No tower or spire shall occupy more than one-fourth of the street frontage of any building to which it is attached and in no case shall the base area exceed sixteen hundred square feet (1600 sq. ft.) unless it conforms entirely to the type of construction requirements of the building to which it is attached and is limited in height as a main part of the building. If the area of the tower or spire exceeds one hundred square feet (100 sq. ft.) at any horizontal cross section, its supporting frame shall extend directly to the ground. The roof covering of spires shall be as required for the main roof of the rest of the structure.

Skeleton towers used as radio masts and placed on the roof of any building shall be constructed entirely of incombustible materials when more than twenty-five feet (25') in height and shall be directly supported on an incombustible framework to the ground. They shall be designed to withstand a wind load from any direction as specified in Section 2307 in addition to any other loads.

## CHAPTER 37—CHIMNEYS, FLUES, VENTS, AND FIREPLACES

**Sec. 3701. (a) General.** Chimneys, flues, vents, and fireplaces, and their connections, carrying products of combustion, shall conform to the requirements of this Chapter. **Scope**

**(b) Equipment and Appliances.** Equipment and appliances shall be of approved types and shall be installed in full compliance with the conditions of approval, special limitations of use, and the manufacturer's instructions.

**(c) Definitions.** **APPLIANCES, HIGH-HEAT,** are any installation or equipment in which the temperature of the flue gases as they enter the flue is above 1500° F. to be measured at the outlet of the appliance or at the outlet of the draft hood attached to the appliance. **Definitions**

**APPLIANCES, LOW-HEAT,** are any installation or equipment in which the temperature of the flue gases is up to 550° F. to be measured at the outlet of the appliance or at the outlet of the draft hood attached to the appliance.

**APPLIANCES, MEDIUM-HEAT,** are any installation or equipment in which the temperature of the flue gases as they enter the flue is from 550° F. to 1500° F. to be measured at the outlet of the appliance or at the outlet of the draft hood attached to the appliance.

**CHIMNEYS, FLUES, or VENTS** are conduits or passages, vertical or nearly so, for conveying products of combustion to the outer air.

1. **Type A.** Chimneys, flues, or vents of masonry, reinforced concrete, metal smokestacks and approved special flues.

2. **Type B.** Flues or vents of incombustible, corrosion-resistant material of sufficient thickness, cross-sectional area, and heat-insulating quality to avoid excess temperature on adjacent combustible material and certified by a nationally recognized agency.

3. **Type C.** Flues or vents of sheet copper of not less than No. 24 gauge U. S. Standard or of galvanized iron of not less than No. 20 gauge U. S. Standard or of other approved corrosion-resistant material.

**FIREBRICK** is any refractory fire-clay brick which meets the requirements of U.B.C. Standard No. 37-1.

**FIRE-CLAY FLUE LINING** is flue lining made of materials conforming to the definition of fire clay as set forth in U.B.C. Standard No. 37-2.

**FLUE OR VENT CONNECTOR** is the pipe connecting a low-heat appliance with the flue or vent.

**SMOKE PIPE** is the pipe connecting a medium- or high-heat appliance with the flue or vent.

**VENT.** See "Chimneys, Flues, or Vents."

**Chimneys**

**Sec. 3702. (a) Structural Design.** Chimneys shall be designed, anchored, supported, and reinforced when so designed as required in this Chapter and Chapters 23 and 28. No chimney shall support any structural load other than its own weight. Chimneys in wood frame buildings shall be anchored laterally at the ceiling line and at each floor line which is more than six feet (6') above grade, except when entirely within the framework.

(b) **Walls.** Every chimney shall have solid masonry or reinforced concrete walls at least eight inches (8") thick in addition to the lining of fire-clay flue lining or firebrick.

**EXCEPTION:** Chimneys not exceeding thirty feet (30') in height and serving medium-heat appliances may have a fire-clay flue lining surrounded by four inches (4") of brick. (See Section 3713.)

(c) **Flue Lining.** Fire-clay flue lining shall be not less than five-eighths inch ( $\frac{5}{8}$ ") thick. The lining shall extend from eight inches (8") below the lowest inlet or, in the case of fireplaces, from the throat of the fireplace to a point at least four inches (4") above enclosing masonry walls. Fire-clay flue linings shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fire-clay mortar, with close-fitting joints left smooth on the inside. Firebrick may be used in place of fire-clay flue lining and shall be not less than two inches (2") thick.

(d) **Flue Area.** No flue shall be smaller in area than the flue connection on the appliance attached thereto nor less than as set forth in Table No. 37-A.

(e) **Height.** Every chimney shall extend at least two feet (2') above the part of the roof through which it passes and at least two feet (2') above the highest elevation of any

**TABLE NO. 37-A—FLUE AREA FOR SOLID OR LIQUID FUELS**

| TYPE OF EQUIPMENT            | MINIMUM AREA OF FLUE                   |  |  |
|------------------------------|--|--|--|
|                              | LINED                                  |  | UNLINED                                |
|                              | ROUND                                  | RECTANGLE                              |  |
| Small Stoves and Heaters     | 28 sq. in.                             | 36 sq. in.                             | 64 sq. in.                             |
| Ranges and Room Heaters      | 40 sq. in.                             | 50 sq. in.                             | 85 sq. in.                             |
| Fireplaces                   | 1/12 of opening<br>—minimum 50 sq. in. | 1/10 of opening<br>—minimum 64 sq. in. | 1/8 of opening<br>—minimum 100 sq. in. |
| Warm-Air Furnaces or Boilers | 70 sq. in.                             | 90 sq. in.                             | 135 sq. in.                            |

Note: For altitudes over two thousand feet (2000') above sea level the Building Official shall be consulted in determining the area of the flue.

part of the building within ten feet (10') of the chimney. **Chimneys**  
The Building Official may approve a chimney of lesser height (Cont'd.)  
installed with an approved vent cowl having a spark arrester  
whose opening shall be not less than six feet (6') from any  
part of the building measured horizontally. For altitudes  
over two thousand feet (2000') the Building Official shall be  
consulted in determining the height of the chimney.

(f) **Corbeling.** No chimney shall be corbeled from a wall  
more than six inches (6"); nor shall a chimney be cor-  
beled from a wall which is less than twelve inches (12") in  
thickness unless it projects equally on each side of the wall.  
In the second story of a two-story building of Group I oc-  
cupancy, corbeling of chimneys on the exterior of the en-  
closing walls may equal the wall thickness. In every case  
the corbeling shall not exceed one-inch (1") projection for  
each course of brick.

(g) **Change in Size or Shape.** No change in the size or  
shape of a chimney where the chimney passes through  
the roof shall be made within a distance of six inches (6")  
above or below the roof joists or rafters.

(h) **Separation of Chimney Liners.** When more than one  
flue or vent is contained in the same chimney, masonry  
separation at least four inches (4") thick bonded into the  
masonry wall of the chimney shall be provided to separate  
flues in pairs or singly.

(i) **Inlets.** Every inlet to any chimney shall enter the  
side thereof and shall be of not less than one-eighth-inch  
( $\frac{1}{8}$ ") thick metal or five-eighths-inch ( $\frac{5}{8}$ ") thick refractory  
material.

(j) **Clearance.** Combustible material shall not be placed  
within two inches (2") of smoke chambers, or chimneys  
when built entirely within a structure, or within one inch  
(1") when the chimney is built entirely outside the struc-  
ture. For special conditions covering fireplaces see Section  
3713.

**Sec. 3703. (a) Low-Heat Appliances.** Masonry chimneys  
serving low-heat appliances shall meet the requirements  
specified in Section 3702. **Types of Chimneys  
Required**

(b) **Medium-Heat Appliances.** Masonry chimneys serving  
medium-heat appliances shall meet the requirements speci-  
fied in Section 3702.

(c) **High-Heat Appliances.** Masonry chimneys serving  
high-heat appliances shall be built with double walls, each  
not less than eight inches (8") in thickness with an air space  
of not less than two inches (2") between them. The inside  
of the interior walls shall be of firebrick not less than four  
inches (4") in thickness laid in fire-clay mortar or refrac-  
tory cement.

(d) **Special Conditions.** Chimneys of cupola furnaces,  
blast furnaces, and similar devices hereafter erected, shall

**Types of  
Chimneys  
Required  
(Cont'd.)**

extend at least twenty feet (20') above the highest point of any roof within a radius of fifty feet (50') thereof. No woodwork or other combustible material or construction, whether protected or unprotected, shall be erected or placed within three feet (3') of any part of such chimney.

(e) **Incinerators.** Masonry chimneys for incinerators in buildings of Group I occupancy shall be lined with fire-clay flue lining and shall have walls of not less than four inches (4") of solid masonry or reinforced concrete. Chimneys for incinerators using the flue as a refuse chute where the horizontal grate area of combustion chamber does not exceed nine square feet (9 sq. ft.) shall have walls of solid masonry or reinforced concrete, not less than four inches (4") thick with a flue lining as specified in Subsection (c) of this Section. If the grate area of such an incinerator exceeds nine square feet (9 sq. ft.), walls shall be not less than four inches (4") thick and shall be lined with not less than four inches (4") of firebrick, except that higher than thirty feet (30') above the roof of the combustion chamber, common brick alone, eight inches (8") in thickness, may be used.

Chimneys for commercial and industrial type incinerators of a size designed for not more than 250 pounds of refuse per hour and having a horizontal grate area not exceeding nine square feet (9 sq. ft.) shall have walls of solid masonry or reinforced concrete not less than four inches (4") thick, with lining of not less than four inches (4") of firebrick, which lining shall extend for not less than forty feet (40') above the roof of the combustion chamber. If the design capacity or grate area of such an incinerator exceeds 250 pounds per hour and nine square feet (9 sq. ft.) respectively, walls shall be not less than eight inches (8") thick, lined with not less than four inches (4") of firebrick extending for the full height of the flue.

All incinerator chimneys shall terminate in a substantially constructed spark arrester having a mesh not exceeding three-fourths inch ( $\frac{3}{4}$ ").

**Metal  
Smokestacks**

**Sec. 3704. (a) Design.** Metal smokestacks shall be designed and constructed as specified in Chapter 27.

(b) **Construction and Support.** Metal smokestacks shall be properly riveted or welded and, unless structurally self-supporting, shall be guyed securely, or firmly anchored to or otherwise supported by the building or structure served thereby.

Metal smokestacks used for high-heat appliances shall be lined with four inches (4") firebrick laid in fire-clay mortar extending not less than twenty-five feet (25') above the smoke pipe entrance.

(c) **Height.** Metal smokestacks shall extend to a height of not less than ten feet (10') above the elevation of any part of a roof within twenty-five feet (25').

(d) **Cleanouts.** Cleanout openings shall be provided at the base of every metal smokestack.

(e) **Exterior Stacks.** Metal smokestacks, or parts thereof, erected on the exterior of a building shall have a clearance of twenty-four inches (24") from combustible walls and four inches (4") from incombustible walls. No such stack shall be nearer than twenty-four inches (24") in any direction from a door, window, or other wall opening or from an exit.

**Metal  
Smokestacks  
(Cont'd.)**

(f) **Interior Stacks.** Metal smokestacks, or parts thereof, in a building other than a one-story building, shall be enclosed above the story in which the appliance served thereby is located, in walls of incombustible construction having a fire-resistance rating of not less than one hour, with a space on all sides between the stack and the enclosing walls sufficient to render the entire stack accessible for examination and repair.

The enclosing walls shall be without openings, except doorways equipped with approved self-closing fire doors of Class "B" type or better at various floor levels for inspection purposes. Where such a stack passes through a roof constructed of combustible materials, it shall be guarded by a galvanized-iron ventilating thimble extending not less than nine inches (9") below and nine inches (9") above such roof construction. Such thimbles shall be of a size to provide a clearance on all sides of the stack of not less than eighteen inches (18"); provided that for stacks of low-heat appliances, the clearance may be reduced to not less than six inches (6"). Smokestacks shall not be carried up inside of ventilating ducts unless such ducts are constructed as required by this Section for smokestacks or smoke flues and such stacks or flues are used solely for venting the room or space in which the appliance served by the smokestack is located.

**Sec. 3705.** Type A flues or vents shall consist of chimneys, metal smokestacks, and approved special flues. Type A flues or vents shall be required for (1) solid- and liquid-fuel-burning heating equipment, and (2) gas-burning equipment which produces flue-gas temperatures in excess of 550° F. at the outlet of the appliance or the draft hood when burning gas at the input rating specified by the manufacturer of such equipment.

**Type A  
Flues or  
Vents**

**Sec. 3706. (a) Material.** Type B flues or vents shall consist of approved vent piping of incombustible, corrosion-resistant material of sufficient thickness, cross-sectional area, and heat-insulating quality to avoid excess temperature on any adjacent combustible material as determined by tests made by a recognized testing laboratory.

**Type B  
Flues or  
Vents**

(b) **Use.** Type B flues or vents may be used only to vent gas-fired appliances approved for maximum flue-gas temperature of 550° F. at the outlet of the appliance or the draft hood. (See Chapter 51, Appendix.)

(c) **Installation. 1. Joints.** Type B flues or vents shall be

**Type B  
Flues or  
Vents  
(Cont'd.)**

made up with tight joints. Flue pipe cement if used shall be acid resisting.

**2. Clearances.** Type B flues or vents shall be installed with a clearance to combustible material of not less than one inch (1") or shall be located in such a manner that continued operation of the appliance will not raise the temperature of surrounding combustible construction more than 90° F. above normal room temperature when measured with a mercury thermometer or conventional bead-type thermocouples.

Flue or vent piping requiring a clearance greater than one inch (1") to avoid excess temperature on adjacent combustible material, or which requires ventilated clearances, shall be installed in accordance with the conditions of approval and listing by the testing laboratory.

Flue or vent piping approved for less than one-inch (1") clearance from combustible materials may be installed in accordance with the conditions of approval and listing by the testing laboratory.

**3. Protection against injury.** Suitable provisions shall be made to prevent mechanical injury to Type B flues and vents where they extend through walls, floors, or roof.

**4. Support.** Flue or vent piping shall be supported at each joint.

**5. Size.** The gravity flue or vent to which the flue or vent connector is connected shall be of a size not less than the flue collar on the appliance attached thereto. In no case shall the area be less than the area of four-inch (4") diameter pipe. When more than one appliance vents into a flue or vent, the flue or vent area shall be not less than the area of the largest flue or vent connector plus 50 per cent of the areas of the additional flue or vent connectors. An oval flue or vent may be used provided its area is not less than the area of the round pipe for which it is substituted. The minimum interior dimension shall be not less than two inches (2"). Unless specified by the manufacturer and approved by the Building Official, no damper shall be installed in any gas vent or flue.

**6. Height.** Each gas vent shall extend above the roof surface and through its flashing and shall terminate in an approved cap with a venting capacity not less than that of the vent. The outlet opening of any such vent shall be not less than twelve inches (12") from any portion of the building, nor less than four feet (4') from any of that portion of the building or structure which extends at an angle of more than 45 degrees upward from the horizontal. No such vent outlet shall terminate less than four feet (4') from or one foot (1') above any door, window, or air intake.

No vents shall terminate less than four feet (4') in vertical height above the vent collar of the appliance.

**7. Offset.** A single portion of any flue or vent may extend at an angle of not more than 60 degrees from the vertical.



**Sec. 3707. (a) Use.** Where Type A or B flues or vents are not required, Type C flues or vents may be used provided they meet the limitations of use as specified in this Section.

**Type C  
Flues or  
Vents**

(b) **General.** Type C flues or vents shall be used only for runs directly from the space in which the appliance is located through a roof to the outer air without passing through any attic, concealed space, or floor. No such vent shall extend more than three feet (3') above the roof through which it passes.

(c) **Clearances.** Requirements shall be as follows:

1. Clearances between Type C flues or vents and combustible material shall be not less than six inches (6") when used with approved appliances except warm-air heating furnaces.

2. Clearances between Type C flues or vents and combustible material shall be not less than nine inches (9") when used with untested appliances or warm-air heating furnaces.

3. Combustible walls, partitions, and roofs through which Type C flues or vents pass shall be protected at the point of passage by one of the following methods:

A. By metal ventilated thimbles not less than six inches (6") larger in diameter than the flue or vent pipe.

B. By metal thimbles not less than four inches (4") larger in diameter than the pipe with the annular space filled with mineral wool or other approved incombustible insulating material.

(d) **Angle.** A single portion of any flue or vent may extend at an angle of not more than 60 degrees from the vertical.

**Sec. 3708. (a) General.** Special Type "A" flues or vents shall be of approved types and shall be installed in full compliance with the conditions of approval, special limitations of use, and the manufacturer's instructions.

**Special  
Type "A"  
Flues or  
Vents**

(b) **Terra-Cotta Chimneys.** Subject to the approval of the Building Official, terra-cotta chimneys may be installed in buildings of Group I occupancy and shall comply with the requirements of this Section.

1. **Construction.** Terra-cotta chimneys erected on the exterior of a building shall be not less than six inches (6") from all combustible material, except that when encased in an incombustible casing they shall be not less than two inches (2") from combustible materials, as specified in Subsection (b)4. Such chimneys shall be exposed to view for the full length, and if erected in the interior of a building shall be encased in an incombustible casing so arranged as to provide not less than one inch (1") air space between the chimneys and the casing. Such air space shall have ventilating openings top and bottom.

2. **Anchorage.** Terra-cotta chimneys shall be anchored each six feet (6') of their height. Such anchorage shall be designed to withstand a load of not less than 200 pounds applied in any direction.

3. **Support.** Exterior terra-cotta chimneys shall be supported directly on their own foundation or upon an incombustible support. Interior terra-cotta chimneys shall not be supported on brackets but shall be carried on the floor system or directly on their own foundations.

4. **Protection.** Incombustible casings of terra-cotta chimneys specified in Subsection (b) 2 shall be not less than two inches (2") from combustible materials. When terra-cotta chimneys are enclosed, the enclosures shall have ventilating openings at both top and bottom. The support for such chimney shall be protected by four inches (4") of incombustible material in the bottom of the flue.

#### Smoke Pipes

**Sec. 3709. (a) Materials.** Smoke pipes serving fixed appliances shall be of substantial metal construction, but never less than No. 22 gauge U.S. Standard. Smoke pipes serving portable appliances shall be of not less than No. 30 gauge U.S. Standard.

(b) **Smoke Pipe Connections.** Two or more smoke pipes shall not be joined to a single flue or vent unless the common smoke pipe and flue or vent is of sufficient size to serve all the appliances thus connected. The smoke pipe of a heating appliance shall not be connected into the flue or vent of an incinerator which has the rubbish chute identical with the smoke flue.

No flue or vent shall have smoke pipe connections in more than one story of a building, unless provision is made for effectively closing smoke pipe openings with devices made of incombustible materials whenever their use is discontinued temporarily, and completely closing them with masonry when discontinued permanently. Smoke pipes shall be exposed to view throughout their entire length.

(c) **Clearances.** Clearances between smoke pipes and combustible material shall be eighteen inches (18") when used on medium-heat appliances and thirty-six inches (36") when used on high-heat appliances. These clearances may be reduced as set forth in Table No. 51-A.

#### Flue or Vent Connectors

**Sec. 3710. (a) Materials.** Flue or vent connectors shall be of galvanized or copper-bearing steel of not less than 26 gauge U.S. Standard, terra cotta, asbestos-cement, or other approved durable material and shall be exposed to view throughout their entire length. Flue or vent connectors serving portable appliances shall be not less than 30 gauge U.S. Standard.

(b) **Size.** Flue or vent connectors shall be not less in diameter than the flue or vent outlet in the appliance.

(c) **Pitch.** Flue or vent connectors serving appliances other than water heaters shall have a rise of not less than one-half inch ( $\frac{1}{2}$ ") to the foot.

(d) **Length and Support.** The horizontal projected length of the flue or vent connector shall not exceed 75 per cent of the vertical projected length of the flue or vent. Horizontal runs shall be as short and as direct as possible. Connectors shall be securely supported at each joint.

(e) **Connection to Flue or Vent.** Flue or vent connectors which enter flues or vents installed in exterior walls or outside of buildings shall be connected by means of tees. Where atmospheric conditions require, provision for removal of condensate shall be provided. Any two inlets shall be separated vertically by not less than the diameter of the larger inlet.

(f) **Clearances.** Clearances between Type C flue or vent connectors and combustible material shall be not less than those specified for Type C flues or vents in Subsection 3707 (c), paragraphs 1 and 2.

Clearances between Type B flue or vent connectors shall be not less than those specified for Type B flues or vents in Subsection 3706 (c), paragraph 2.

**Sec. 3711.** No flue or vent connector from a gas appliance shall be interconnected with any other flue or vent connector, smoke pipe, or flue, unless such gas appliances are equipped with an automatic device to prevent the escape of unburned gas at the main burner or burners. Where a gas-appliance flue or vent connector is joined with a smoke pipe from an appliance burning some other type of fuel for connection into a single flue opening, they shall be joined by a Y-fitting located as close as practicable to the chimney. With liquefied petroleum gases the automatic device to prevent the escape of unburned gas shall shut off the pilot light as well as the main burner or burners.

All gas appliances connected to the common vent shall be located in the same story of the building.

**Inter-connection  
of Vents**

**Sec. 3712.** Every gas water heater shall have an entirely separate and independent vent, except that not more than four gas water heaters may be connected to a common vent manifold if constructed and installed in accordance with the following additional requirements:

**Water  
Heater  
Vents and  
Manifolds**

1. **Location.** All water heaters connected to the common vent shall be located in the same story of the building.

2. **Vent manifold required.** If more than three feet (3') of vent connector is required to connect a water heater to the common vent, the water heater shall be connected to a vent manifold.

3. **Length of vent manifold.** The length of the vent manifold shall be not greater than 75 per cent of the height of the vertical vent to which it connects, nor shall the length of the vent manifold exceed fifteen feet (15').

4. **Slope.** The vent manifold and vent connector shall slope up at a rate of not less than one-half inch ( $\frac{1}{2}$ " ) per foot of length. The vent manifold shall be located as high as the structure will permit.

5. **Connections.** The connections between individual water heaters and the vent manifolds shall be as direct as possible

**TABLE NO. 37-B—VENT AND VENT MANIFOLD  
FOR GAS HEATERS**

| NUMBER OF<br>GAS WATER<br>HEATERS | MAXIMUM GAS IN-<br>PUT RATING OF<br>ALL GAS WATER<br>HEATERS | MINIMUM INTERNAL<br>DIAMETER OF VENT<br>AND VENT MANIFOLD<br>(Inches) |
|-----------------------------------|--|---|
| 2 or 3                            | 75,000 B.t.u.  | 5   |
| 4                                 | 100,000 B.t.u.   | 6   |
| 4                                 | 200,000 B.t.u.   | 7   |
| 4                                 | 300,000 B.t.u.   | 8   |

and shall have the maximum possible vertical rise above the flue outlet of the water heaters.

6. **Size of vent.** The size of the common vent and the vent manifold shall be not less than the values set forth in Table No. 37-B.

7. **Other designs of vent manifolds.** The use of other arrangements and size of vent gas connectors and piping for interconnected vents and vent manifolds may be permitted when approved by the Building Official.

## Fireplaces

**Sec. 3713.** Fireplaces, smoke chambers, and fireplace chimneys shall be of solid masonry or reinforced concrete and shall conform to the following minimum requirements:

1. **Fireplace walls.** Structural walls of fireplaces shall be not less than eight inches (8") in thickness. Back walls of fireboxes shall be not less than ten inches (10") in thickness, except that where a lining of firebrick is used such back walls shall be not less than eight inches (8") in thickness.

2. **Metal heat circulators.** Approved metal heat circulators may be installed in fireplaces.

3. **Smoke chamber.** Front and side walls shall be not less than eight inches (8") in thickness. Smoke chamber back walls shall be not less than six inches (6") in thickness.

4. **Fireplace chimneys.** Walls shall be not less than eight inches (8") in thickness, or when lined with fire-clay flue lining, not less than four inches (4") in thickness. [See Section 3702 (c).]

Where necessary, such chimneys may be corbeled at a slope of not more than four inches (4") in twenty-four inches (24") but not more than one third the dimension of the chimney in the direction of the corbeling. Where lined, the lining shall be accurately cut to fit.

5. **Clearance.** Combustible material shall not be placed within two inches (2") of fireplaces, smoke chambers, or chimneys when built entirely within a structure, or within one inch (1") when the chimney is built entirely outside the structure. Combustible materials shall not be placed within six inches (6") of the fireplace opening. No such

combustible material within twelve inches (12") of the fireplace opening shall project more than one-eighth inch ( $\frac{1}{8}$ ") for each one-inch (1") clearance from such opening. **Fireplaces (Cont'd.)**

6. **Areas of flues, throats, and dampers.** The net cross-sectional area of the flue and of the throat between the firebox and the smoke chamber of a fireplace shall be not less than as set forth in Table No. 37-A. Where dampers are used, damper openings shall be not less in area, when fully opened, than the required flue area.

7. **Lintel.** Masonry over the fireplace opening shall be supported by an incombustible lintel.

8. **Hearth.** Every fireplace shall be provided with a brick, concrete, stone, or other approved incombustible hearth slab at least twelve inches (12") wider on each side than the fireplace opening and projecting at least twenty inches (20") therefrom. This slab shall be not less than four inches (4") thick and shall be supported by incombustible materials or reinforced to carry its own weight and all imposed loads. Combustible forms and centering shall be removed.

9. **Fire-stopping.** Fire-stopping between chimneys and wooden construction shall meet the requirements specified in Section 2512.

10. **Nonconforming fireplaces.** Imitation and other fireplaces not conforming to the other requirements of this Section shall not exceed six inches (6") in depth. Gas-burning appliances may be installed in such nonconforming fireplaces provided that compliance is made with the requirements of this Chapter on flues or vents and clearances from combustible materials in Chapter 51, Appendix.

11. **Support.** Fireplaces shall be supported on foundations designed as specified in Chapters 23, 24, and 28.

## CHAPTER 38—FIRE-EXTINGUISHING SYSTEMS

### Automatic Fire- Extinguishing Systems: Where Required

**Sec. 3801.** Standard automatic fire-extinguishing systems shall be installed as specified in this Chapter in the following places:

1. In every story or basement of a building when the floor area exceeds fifteen hundred square feet (1500 sq. ft.) and there is not provided at least twenty square feet (20 sq. ft.) of opening in each fifty lineal feet (50 lin. ft.) or fraction thereof of exterior wall in the story or basement on at least one side of the building. Openings shall have a minimum dimension of not less than thirty inches (30").

2. In all cellars in Group A and B occupancies and in other cellars when the floor area exceeds fifteen hundred square feet (1500 sq. ft.).

3. In the following locations in Group A occupancies and Divisions 1 and 2, Group B occupancies having a stage or enclosed platform:

A. In all dressing-room sections, workshops, and store-rooms.

B. Where there is a stage; under the gridiron, stage floor, tie and fly galleries, and in all places back of the proscenium wall.

C. Over enclosed platforms having an area of more than one thousand square feet (1000 sq. ft.) and over any usable space under such platforms.

4. In any enclosed occupied space in Group B, C, and D occupancies below or over a stairway, except where the entire construction is as required for Type I or II buildings, and in all portions of basements or cellars used for storage or maintenance work rooms.

5. In Divisions 1 and 2, Group E occupancies having an area of more than fifteen hundred square feet (1500 sq. ft.); in Division 3, Group E occupancies having an area of more than three thousand square feet (3000 sq. ft.); and in Division 4, Group E occupancies more than one story in height.

### Detailed Requirements

**Sec. 3802.** Required automatic fire-extinguishing systems shall comply in all respects with the regulations set forth in U.B.C. Standards No. 38-1 or No. 38-2.

**EXCEPTIONS:** 1. A single water supply equal to the primary supply required by such regulations may be accepted as complying with the requirements of this Code.

In no case where a connection to a public-utility water main constitutes the source of supply shall such connection be less than four inches (4") in diameter.

2. Automatic fire-extinguishing systems required in paragraph 5, Section 3801, may be supplied from the domes-

tic water system and need not comply with the provisions of this Section except as to pipe sizes and spacing of heads, provided that where the domestic water supply has a pressure less than 15 pounds per square inch, an approved automatic chemical extinguisher may be used in lieu of the automatic fire-extinguishing system.

3. The alarm valve required for a standard automatic fire-extinguishing system shall not be required in the cellars of Group B, C, D, E, F, G, and H occupancies where the area of such cellar is less than three thousand square feet (3000 sq. ft.).

**Sec. 3803.** Every building four or more stories in height shall be equipped with one or more dry standpipes.

**Detailed  
Requirements  
(Cont'd.)**

**Dry  
Standpipes**

**Sec. 3804. (a) Construction.** Dry standpipes shall be of wrought iron or galvanized steel and together with fittings and connections shall be of sufficient strength to withstand 300 pounds of water pressure to the square inch when ready for service, without leaking at the joints, valves, or fittings.

**Dry  
Standpipes:  
Detailed  
Requirements**

Tests shall be conducted by the owner or contractor in the presence of a representative of the Fire Department whenever deemed necessary and ordered by the Building Official. The tests shall be applied at the top and bottom connections of such standpipes and the owner or contractor shall be responsible for any damage caused by breakage or faulty installation while such tests are being conducted. After such standpipes have been tested, the owner or contractor shall remove all water therefrom.

(b) **Size.** Dry standpipes shall be of such a size as to be capable of delivering 250 gallons per minute from each of any three outlets simultaneously under the pressure created by one fire engine or pumper, based on the existing city equipment available. No part of a dry-standpipe system other than hose connections shall be less than three inches (3") in diameter.

(c) **Number Required.** Every building four or more stories in height where the area of any floor above the third floor is ten thousand square feet (10,000 sq. ft.) or less shall be equipped with not less than one dry standpipe and an additional standpipe shall be installed for each additional ten thousand square feet (10,000 sq. ft.) or fraction thereof.

(d) **Location.** Standpipes shall be located within stairway enclosures or as near such stairways as possible or shall be on the outside of, embedded within, or immediately inside of an exterior wall and within one foot (1') of an opening in a stairway enclosure or the balcony or vestibule of a smoke-proof tower or an outside exit stairway.

(e) **Siamese Connections.** All four-inch (4") dry standpipes shall be equipped with a two-way Siamese fire department connection. All five-inch (5") dry standpipes shall be equipped with a three-way Siamese fire department connection and all six-inch (6") dry standpipes shall be equipped

**Dry  
Standpipes:  
Detailed  
Requirements  
(Cont'd.)**

with a four-way Siamese fire department connection. All Siamese inlet connections shall be located on a street front of the building and not less than one foot (1') nor more than four feet (4') above the grade and shall be equipped with clapper-checks and substantial plugs. All Siamese inlet connections shall be recessed in the wall or otherwise substantially protected.

(f) **Outlets.** All dry standpipes shall extend from the ground floor to and over the roof and shall be equipped with a two and one-half inch (2½") outlet not more than four feet (4') above the floor level at each story. All dry standpipes shall be equipped with a two-way two and one-half inch (2½") outlet above the roof. All outlets shall be equipped with gate valves with substantial chains.

(g) **Threads.** All hose threads in connection with such standpipe installations shall be uniform with that used by the local fire department.

(h) **Signs.** An iron or bronze sign with raised letters at least one inch (1") high shall be rigidly attached to the building adjacent to all Siamese connections and such sign shall read: "CONNECTION TO DRY STANDPIPE."

**Wet  
Standpipes:  
Where  
Required**

**Sec. 3805.** Every Group A and B occupancy of any height, and every Group C occupancy two or more stories in height, and every Group D, E, F, G, and H occupancy three or more stories in height and every Group E and F occupancy over 20,000 square feet in area shall be equipped with one or more interior wet standpipes extending from the cellar or basement into the topmost story, provided that Group B buildings having no stage and having a seating capacity of less than 500 need not be equipped with interior standpipes.

**Wet  
Standpipes:  
Detailed  
Requirements**

**Sec. 3806. (a) Construction.** Interior wet standpipes shall be constructed as required for dry standpipes.

(b) **Size.** Interior wet standpipes shall have an internal diameter sufficient to deliver 50 gallons of water per minute under 30 pounds per square inch pressure at the hose connection, based on the available water supply. Buildings of Group A and B occupancies shall have wet standpipe systems capable of delivering the required quantity and pressure from any two outlets simultaneously; for all other occupancies only one outlet need be figured to be open at one time. In no case shall the internal diameter of a wet standpipe be less than two inches (2"), except when the standpipe is attached to an automatic fire-extinguishing system as set forth in U.B.C. Standard No. 38-1.

Any approved formula which determines pipe sizes on a pressure drop basis may be used to determine pipe sizes for wet standpipe systems. The Building Official may require delivery and pressure tests on completed wet standpipe systems before approving such systems.

(c) **Number Required.** Wet standpipes shall be so located



that any portion of the building can be reached therefrom with a hose not exceeding seventy-five feet (75') in length.

**Wet  
Standpipes  
(Cont'd.)**

(d) **Location.** In Group A and B occupancies, outlets shall be located as follows:

On each side of the stage, on each side of the rear of the auditorium, and on each side of the rear of the balconies. Where occupant loads are less than 500 the number of locations noted above may be reduced upon the approval of the Building Official. In Group C, D, E, F, G, and H occupancies the location of all interior wet standpipes shall be approved by the Building Official.

(e) **Outlets.** All interior wet standpipes shall be equipped with a one and one-half inch (1½") valve in each story, including the basement or cellar of the building, and located not less than one foot (1') nor more than five feet (5') above the floor.

(f) **Threads.** All hose threads in connection with the installation of such standpipes, including valves and reducing fittings, shall be uniform with that used by the local fire department.

(g) **Water Supplies.** All interior wet standpipes shall be connected to a street water main not less than four inches (4") in diameter, or when the water pressure is insufficient to maintain 30 pounds pressure at the highest hose outlet such standpipe shall be connected to a pressure tank, gravity tank, or fire pump. Such supply shall be sufficient to furnish at least 30 pounds pressure at the topmost standpipe outlet.

When more than one interior wet standpipe is required in the building, such standpipes shall be connected at their bases or at their tops by pipes of equal size.

(h) **Pressure and Gravity Tanks.** Tanks shall have a capacity sufficient to furnish at least 250 gallons per minute for a period of not less than 10 minutes. Such tanks shall be located so as to provide not less than 25 pounds pressure at the topmost hose outlet for its entire supply. Discharge pipes from pressure tanks shall extend two inches (2") into and above the bottom of such tanks. All tanks shall be equipped with a manhole, ladder and platform, drain pipe, water and pressure gauges. Every pressure tank shall be tested in place after installation and proved tight at a hydrostatic pressure 50 per cent in excess of the working pressure required. Where such tanks are used for domestic purposes the supply pipe for such purposes shall be located at or above the center line of such tanks. Incombustible supports shall be provided for all such supply tanks and not less than a three-foot (3') clearance shall be maintained over the top and under the bottom of all pressure tanks.

(i) **Fire Pumps.** Fire pumps shall have a capacity of not less than 250 gallons per minute with a pressure of not less than 25 pounds at the topmost hose outlet. The source of supply for such pump shall be a street water main of not less than four-inch (4") diameter or a well or cistern containing a

**Wet  
Standpipes  
(Cont'd.)**

one-hour supply. Such pumps shall be supplied with an adequate source of power and shall be automatic in operation.

(j) **Hose and Hose Reels.** Each hose outlet of all interior wet standpipes shall be supplied with a hose not less than one and one-half inches (1½") in diameter. Such hose shall be equipped with a suitable brass or bronze nozzle and shall be not over seventy-five feet (75') in length. An approved standard form of wall hose reel or rack shall be provided for the hose and shall be located so as to make the hose readily accessible at all times and shall be recessed in the walls or protected by suitable cabinets.

**Basement  
Pipe  
Inlets**

**Sec. 3807.** Basement pipe inlets shall be installed in the first floor of every store, warehouse, or factory where there are cellars or basements under same, except where in such cellars or basements there is installed a fire-extinguishing system as specified by this Code, or where the cellars or basements are used for banking purposes, safe deposit vaults, or similar uses.

All basement pipe inlets shall be of cast iron, steel, brass, or bronze with lids of cast brass or bronze and shall consist of a sleeve not less than eight inches (8") in diameter through the floor extending to and flush with the ceiling below and with a top flange, recessed with an inside shoulder, to receive the lid and flush with the finish floor surface. The lid shall be a solid casting and have a ring lift recessed in the top thereof, so as to be flush. The lid shall have the words "Fire Department Only, Do Not Cover Up," cast in the top thereof. The lid shall be installed in such a manner as to permit its removal readily from the inlet.

The location of such basement pipe inlets shall be approved by the Building Official and shall be kept readily accessible at all times to the Fire Department.

**Approvals**

**Sec. 3808.** All fire-extinguishing systems, including automatic sprinklers, wet and dry standpipes, automatic chemical extinguishers, basement pipe inlets and the appurtenances thereto shall meet the approval of the chief of the Fire Department as to installation and location and shall be subject to such periodic tests as he may require.

**CHAPTER 39—STAGES AND PLATFORMS**

**Sec. 3901.** There shall be one or more ventilators constructed of metal or other incombustible material near the center and above the highest part of any working stage raised above the stage roof and having a total ventilation area equal to at least 5 per cent of the floor area within the stage walls. The entire equipment shall conform to the following requirements or their equivalent:

**Stage Ventilators**

1. Doors shall open by force of gravity sufficient to overcome the effects of neglect, rust, dirt, frost, snow, or expansion by heat or warping of the framework.

2. Glass, if used in ventilators, must be protected against falling on the stage. A wire screen, if used under the glass, must be so placed that if clogged it cannot reduce the required ventilating area or interfere with the operating mechanism or obstruct the distribution of water from the automatic sprinklers.

3. The doors and other covers shall be arranged to open instantly after the outbreak of fire, by the use of approved automatic fusible links which will fuse and separate at not more than 160 degrees Fahrenheit. A manual control must also be provided by a cord running down to the stage at a point on each side of the stage designated by the Building Official.

4. The fusible link and the cord must hold the doors closed against a force of at least 30 pounds excess counterweight tending to open the door. The fusible links shall be placed in the ventilator above the roof line and in at least two other points in each controlling cord and so located as not to be affected by the sprinkler heads above. Each stage ventilator shall be operated to an open and closed position at least once before each performance.

**Sec. 3902.** Gridirons, fly galleries, and pin-rails shall be constructed of incombustible materials and fire protection of steel and iron may be omitted. Gridirons and fly galleries shall be designed to support not less than 75 pounds live load per square foot.

**Gridirons**

The main counterweight sheave beam shall be designed to support a horizontal and vertical uniformly distributed live load equal to not less than five pounds per square foot over the area of the gridiron directly back of the proscenium opening.

**Sec. 3903.** In buildings having a stage, the dressing-room sections, workshops, and storerooms shall be located on the stage side of the proscenium wall and shall be separated from each other and from the stage by not less than a "Two-Hour Fire-Resistive Occupancy Separation."

**Rooms Accessory to Stage**

**Sec. 3904.** A stage as defined in Section 420 shall be completely separated from the auditorium by a proscenium wall

**Proscenium Walls**

**Proscenium  
Walls  
(Cont'd.)**

of not less than two-hour incombustible construction. The proscenium wall shall extend not less than four feet (4') above the roof over the auditorium.

Proscenium walls may have, in addition to the main proscenium opening, one opening at the orchestra pit level and not more than two openings at the stage floor level, each of which shall be not more than twenty-five square feet (25 sq. ft.) in area.

Openings in the proscenium wall of a stage shall be protected by single Class "A" fire doors. The proscenium opening, which shall be the main opening for viewing performances, shall be provided with a self-closing fire-resistive curtain as provided in Chapter 41.

**Stage  
Floors**

**Sec. 3905.** All parts of stage floors shall be of Type I construction except the part of the stage extending back from and the full width of the proscenium opening, which may be constructed of steel or heavy timbers covered with a wood floor of not less than two inches (2") nominal thickness. No part of the combustible construction except the floor finish shall be carried through the proscenium opening. All parts of the stage floor shall be designed to support not less than 125 pounds per square foot.

Openings through stage floors shall be equipped with tight-fitting trap doors of wood of not less than two inches (2") nominal thickness.

**Platforms**

**Sec. 3906. (a) Ventilators.** There shall be one or more ventilators, conforming to the requirements of Section 3901, except that the total area shall be equal to  $2\frac{1}{2}$  per cent of the area of the platform, located near the center and above the highest part of every enclosed platform having a floor area of five hundred square feet (500 sq. ft.) or more.

**(b) Construction.** Walls and ceiling of an enclosed platform in an assembly room shall be of not less than one-hour fire-resistive construction.

Any usable space having headroom of four feet (4') or more under a raised platform of an assembly room shall be of not less than one-hour fire-resistive construction.

**(c) Accessory Rooms.** In buildings having an enclosed platform, the dressing-room section, workshops, and store-rooms shall be separated from each other and from the rest of the building by not less than a "One-Hour Fire-Resistive Occupancy Separation," except that a chair-storage area having headroom of not more than four feet (4') need not be so separated.

**Stage  
Exits**

**Sec. 3907.** At least one exit two feet six inches (2'6") wide shall be provided from each side of the stage opening directly or by means of a passageway not less than three feet (3') in width to a street or exit court. An exit stair not less than two feet six inches (2'6") wide shall be provided for egress from each fly gallery. Each tier of dressing rooms shall be provided with at least two means of

egress each not less than two feet six inches (2'6") wide and **Stage**  
all such stairs shall be constructed as specified in Chapter 33. **Exits**  
The stairs required in this Section need not be enclosed. **(Cont'd.)**

**Sec. 3908.** A protecting hood shall be provided over the **Miscellaneous**  
full length of the stage switchboard.

**Sec. 3909.** No combustible scenery, drops, props, decora- **Flame-**  
tions, or other combustible effects shall be placed on any **Retarding**  
stage or enclosed platform unless it is treated with an **Requirements**  
effective fire-retardant solution and maintained in a non-  
flammable condition as approved by the Fire Department.

## CHAPTER 40—MOTION PICTURE PROJECTION ROOMS

### General

**Sec. 4001. (a) Scope.** The provisions of this Chapter shall apply only where nitrocellulose film is used.

**(b) Projection Room Required.** Every motion picture machine using nitrocellulose films, together with all electrical devices, rheostats, machines, and all such films present in any Group A, B, or C occupancy, shall be enclosed in a projection room large enough to permit the operator to walk freely on either side and back of the machine.

### Construction

**Sec. 4002.** Every projection room shall be of not less than one-hour fire-resistive construction throughout and the walls and ceiling shall be finished with incombustible material.

The ceiling shall be not less than eight feet (8') from the finished floor. The room shall have a floor area of not less than eighty square feet (80 sq. ft.) and forty square feet (40 sq. ft.) for each additional machine.

### Exits

**Sec. 4003.** Every projection room shall have at least two doorways separated by not less than one-third the perimeter of the room, each at least thirty inches (30") wide and eighty inches (80") high.

The entrances to the projection room shall be protected by Class "C" fire doors as specified in Section 4306. Such doors shall open outward and lead to proper exits as required in Chapter 33 and shall not be equipped with any latch. The maximum width of such door need be no more than thirty inches (30").

### Ports and Openings

**Sec. 4004. (a) Types.** Ports in projection room walls shall be of three kinds: projection ports; observation ports; and combination ports used for both observation and for stereopticon, spot, or floodlight machines.

**(b) Ports Required.** There shall be provided for each motion picture projector not more than one projection port, which shall be limited in area to one hundred and twenty square inches (120 sq. in.), and not more than one observation port, which shall be limited in area to two hundred square inches (200 sq. in.). There shall be not more than three combination ports, each of which shall not exceed thirty inches by twenty-four inches (30" x 24"). Each port opening shall be completely covered with a single pane of glass not less than one-fourth inch ( $\frac{1}{4}$ ") in thickness.

**(c) Shutters.** Each port and every other opening in projection room walls, including any fresh-air inlets but excluding exit doors and exhaust ducts, shall be provided with a shutter of not less than No. 10 U. S. gauge sheet metal or its equivalent large enough to overlap at least one inch (1") on all sides of such opening. Shutters shall be arranged to slide without binding in guides constructed of material equal

to the shutters in strength and fire resistance. Each shutter shall be equipped with a 160-degree Fahrenheit fusible link, which when fused by heat will cause closure of the shutter by gravity. There shall also be a fusible link located over the upper magazine of each projector, which, upon operating, will close all the shutters. In addition, there shall be provided suitable means for manually closing all shutters simultaneously from any projector head and from a point within the projection room near each exit door. Shutters on openings not in use shall be kept closed.

**Ports and  
Openings  
(Cont'd.)**

**Sec. 4005. (a) Inlet.** A fresh-air inlet from the exterior of the building not less than one hundred and forty-four square inches (144 sq. in.) and protected with wire netting shall be installed within two inches (2") of the floor in every projection room, the source of which shall be remote from other outside vents or flues.

**Ventilation**

(b) **Outlets.** Ventilation shall be provided by one or more mechanical exhaust systems which shall draw air from each arc lamp housing and from one or more points near the ceiling. Systems shall exhaust to outdoors either directly or through a noncombustible flue used for no other purpose. Exhaust capacity shall be not less than fifteen cubic feet (15 cu. ft.) nor more than fifty cubic feet (50 cu. ft.) per minute for each arc lamp plus two hundred cubic feet (200 cu. ft.) per minute for the room itself. Systems shall be controlled from within the enclosure and have pilot lights to indicate operation. The exhaust system serving the projection room may be extended to cover rooms associated therewith such as rewind rooms. No dampers shall be installed in such exhaust systems.

Ventilation of these rooms shall not be connected in any way with ventilating or air-conditioning systems serving other portions of the building.

(c) **Exhaust Ducts.** Exhaust ducts shall be of incombustible material, and shall either be kept one inch (1") from combustible material or covered with one-half inch ( $\frac{1}{2}$ ") of incombustible heat-insulating material.

**Sec. 4006. (a) Shelves and Fixtures.** All shelves, fixtures, and fixed equipment in a projection room shall be constructed of incombustible materials.

**Regulation  
of Equipment**

(b) **Films.** All films not in actual use shall be stored in metal cabinets having individual compartments for reels or shall be in I.C.C. shipping containers. Metal used in the construction of cabinets shall be not less than No. 18 U. S. Standard gauge. No solder shall be used in the construction of such metal cabinets.

**Sec. 4007.** Every projection room shall be provided with an unenclosed water closet and lavatory.

**Sanitary  
Requirements**

**CHAPTER 41—PROSCENIUM CURTAINS****General  
Requirements**

**Sec. 4101.** Proscenium curtains when required shall be made of incombustible materials constructed and mounted so as to intercept hot gases, flames, and smoke, and to prevent glow from a severe fire on the stage showing on the auditorium side within a period of five minutes. The closing of the curtain from the full open position shall be effected in less than thirty seconds, but the last five feet (5') of travel shall require not less than five seconds.

**Curtain  
Coverings**

**Sec. 4102.** A proscenium curtain shall be constructed and installed as specified in this Chapter. The curtain shall be made of one thickness of asbestos cloth weighing not less than three and one-fourth pounds per square yard.

The asbestos cloth used in the construction of the curtain shall have incorporated into the yarn before weaving, either monel metal, nickel, brass, or other metal or alloy having not less strength than these metals at temperatures up to 1700 degrees Fahrenheit and no less resistance to corrosion at ordinary temperatures. Asbestos cloth made of long fiber blue crocidolite asbestos may be used in place of chrysotile asbestos cloth of the same weight. The wires used to reinforce the yarn shall be either single or double but the tensile strength of each wire shall be sufficient to support a load of not less than three pounds at ordinary temperatures, and the strength of two strands of yarn and one wire twisted together shall be sufficient to support a load of six pounds. The strength of the cloth in tension when tested by the strip method shall be not less than 160 pounds per inch of width of warp and 52 pounds per inch of filling.

The asbestos fiber of yarns may contain cotton or other combustible fiber not to exceed 20 per cent of the weight of the asbestos. The total carbon content of the cloth shall not exceed 10 per cent of the total weight of the fiber. When required by the Building Official, a sample of the cloth of sufficient size for testing shall be submitted.

In addition to any decoration, the curtain shall be painted on both sides with a mineral paint having a silicate of soda binder, which will completely fill the cloth. Filler paint shall have not less than four parts of casein in each 10 parts of silicate of soda. This paint shall be well brushed into the cloth so that no light or smoke can come through.

**Design and  
Construction**

**Sec. 4103.** The curtain shall be made of continuous vertical strips of asbestos cloth. The widths of cloth shall overlap at the seams not less than one inch (1") and shall be sewed with a double row of stitching of asbestos thread.

The curtain shall be wide enough to extend into steel smoke grooves on each side of the proscenium opening at least eight inches (8") and shall overlap the top and sides of the proscenium opening at least twelve inches (12").

Six-inch (6") pockets shall be sewed in the top and the bottom of the curtain to hold the pipe battens; the sides shall be hemmed at least six inches (6") deep. A two-inch (2") pipe batten shall be placed at the top and a one and



one-half inch ( $1\frac{1}{2}$ " ) batten at the bottom. For stage openings over forty feet (40') in width the bottom batten shall be not less than two and one-half inches ( $2\frac{1}{2}$ " ) in diameter. The battens shall be reinforced at the joints with twelve-inch (12" ) sections of pipe housed and riveted.

**Design and  
Construction  
(Cont'd.)**

The curtain shall be held to the steel guides in the smoke pockets with substantial roller grips riveted or bolted to the side hem, not more than eighteen inches (18" ) on center. Each roller grip shall be fastened to the curtain with not less than three bolts or rivets.

No. 16 U. S. gauge galvanized metal shall be bent and placed vertically along each side hem of the curtain material, so that both faces of the hem are covered not less than six inches (6" ). This metal edging shall be fastened to the side hem with rivets spaced not more than six inches (6" ) on center.

The top of the curtain shall have a smoke stop fitted to make it as smoke-tight as practicable. The bottom of the curtain shall have a yielding pad of incombustible material not less than three inches (3" ) thick to form a seal against the floor.

**Sec. 4104.** Smoke grooves which protect the sides of the curtain shall be of structural steel shapes and plates not less than one-fourth inch ( $\frac{1}{4}$ " ) thick. These grooves shall be not less than fourteen inches (14" ) deep and six inches (6" ) wide and shall be set back from the face of the arch at least six inches (6" ). Grooves shall extend from the stage floor to a point three feet (3' ) above the top of the raised curtain, and shall be securely bolted to the proscenium wall. Details of the grooves shall be submitted to the Building Official and Fire Chief for approval.

**Operating  
Equipment**

Steel tracks shall be built into the smoke grooves upon which shall travel the roller curtain guides, and shall be installed rigidly in place and so that roller guides will operate smoothly. Safe support and smooth operation are required with a wind load of one pound per square foot over the entire area of the curtain.

Support for the curtain shall be by means of one-fourth-inch ( $\frac{1}{4}$ " ) flexible steel cables for curtains forty feet (40' ) or less in width, and three-eighths-inch ( $\frac{3}{8}$ " ) flexible steel cables for curtains over forty feet (40' ) in width. These cables shall be spaced not more than twelve feet (12' ) on center, and the end overhang shall be not more than fifteen inches (15" ). Supporting cables shall be tied to the top batten with a clove-hitch and the end secured with two iron rope clips. A substitute method of attachment will be allowed if approved by the Building Official.

The supporting cables shall pass through sheaves in the gridiron and over to the counterweight guides and shall fasten to the counterweight by means of three-eighths-inch ( $\frac{3}{8}$ " ) turnbuckles with clove-hitches and cable clips. Turnbuckles shall be locked to prevent backing out. Weight of the curtains shall be evenly divided on the cables.

There shall be safety stay chains of straight welded link

**Operating  
Equipment  
(Cont'd.)**

fastened to the top curtain batten of sufficient strength to support safely the weight of the curtain. There shall be one more stay chain than the number of supporting cables and, except for the stay chains at the ends of the curtain, all stay chains shall be centered between the supporting cables. Stay chains shall be securely attached to the top batten of the curtain and thence to the gridiron, if of steel construction, or shall be bolted through the proscenium wall with three-fourth-inch ( $\frac{3}{4}$ " ) bolts. Safety chains shall be so adjusted that they support the curtain when it is lowered and the bottom batten is resting on the pad supported by the floor.

All cables shall be carried over head and loft blocks fitted with ball or roller bearings of ample capacity to accommodate the weight at the speeds required. Grooves in the blocks shall be machined properly to cradle and protect the cable. All blocks supporting the proscenium curtain shall be supported on the proscenium wall by means of steel brackets of suitable size safely to carry the weight, or shall be mounted on structural steel beams.

Blocks shall be installed so that the head block is sufficiently higher than the loft blocks to prevent cables from fouling loft block housings.

Diameters of the blocks shall be a minimum of twelve inches (12") for three-line sets and sixteen inches (16") for all other sets.

The mechanism and devices for controlling the curtain shall be of simple design and shall be positive in operation. Opening of the curtain shall be by hydraulic or electric power. For curtains where the overbalance on the curtain side does not exceed 150 pounds, manual operation may be used. In this case, manual operation will be allowable only if a method is provided which allows the curtain and counterbalance to be approximately equal under normal conditions, but which adds the required overweight on the curtain side automatically in case of an emergency.

Emergency release shall be by gravity obtained by overbalancing the curtain. The emergency control line shall be of cotton sash cord, fitted with not less than four fusible links, one on each side of the stage and two overhead in the gridiron, which when the links are fused or the sash cord burned will allow the curtain to lower itself automatically. This control line shall extend up both sides of the proscenium arch and across the gridiron, and shall be so arranged that when released it will also automatically open the stage ventilators.

On each side of the proscenium arch, at a location in plain view, shall be located an easily read sign bearing the inscription: "In case of fire, cut line to lower fire curtain," with an indicator pointing to the location of a knife for that purpose. The knives shall be attached to the wall by a chain sufficiently long to reach the release line.

For electric operation there shall be installed push buttons plainly marked: "Fire Curtain—stop: Fire Curtain—down."

One set of control buttons shall be installed on each side of the proscenium opening. For hydraulic or manual operation the endless line shall be marked plainly with an arrow pointing the direction for closing.

**Operating  
Equipment  
(Cont'd.)**

For manual operation the operating hand line shall be not less than three-fourths-inch ( $\frac{3}{4}$ " ) diameter manila rope secured to the top and bottom of the counterweight arbor, and shall pass under a floor block, adjustable for tension, of not less than twelve-inch (12" ) diameter.

The top and bottom counterweight sections of the arbor shall be of cast iron, sufficiently heavy to accommodate safely the loads. The top and bottom sections shall be connected with rods not less than three-fourths inch ( $\frac{3}{4}$ " ) in diameter, with one tie plate for every four feet (4' ) of rod. There shall be smooth grooves on the ends of the top and bottom weights which engage the steel guides. Intermediate weights shall be of cast iron, grooved to drop into place on top of the lower carrying weight. The turnbuckles connecting the supporting cables to the top weight shall be attached to eyebolts passing through the top weight.

Counterweight guide tracks shall be structural "T's" or angles, properly tied together and securely anchored to the proscenium wall. All joints where the counterweight travels shall be ground smooth and a liberal coating of grease shall be applied to the tracks. These guides shall extend from the gridiron a length equivalent to the length of the arbor, plus the travel of the curtain, plus five feet (5' ). The specified length shall be considered as the minimum. A structural steel stop shall be provided at the bottom of the arbor.

For proscenium curtains in which the overbalance is in excess of 150 pounds, an approved adjustable checking device shall be installed to check the speed of fall during the last five feet (5' ) of travel and an alarm shall be installed at the center of the top of the proscenium arch, which will sound when the curtain is descending through the emergency release.

**Sec. 4105.** The complete installation of every proscenium curtain shall be subjected to operating tests and any theater in which such proscenium curtain is placed shall not be opened to public performances until after the proscenium curtain has been accepted and approved by the Building Official.

**Tests**

**Sec. 4106.** Curtains of other designs and materials, when not obviously of greater fire resistance than specified in this Chapter, shall before acceptance be subjected to the standard fire test specified in Chapter 43, as applicable to non-bearing partitions, except that such tests shall be continued only for a period of five minutes unless failure shall have occurred previously. The unexposed face of the curtain shall not glow within a period of five minutes nor shall there be any passage of smoke or flame through the curtain.

**New  
Designs**

**PART VIII****FIRE-RESISTIVE STANDARDS  
FOR FIRE PROTECTION****CHAPTER 42—INTERIOR WALL AND  
CEILING FINISH****General**

**Sec. 4201.** Interior wall and ceiling finish shall mean interior wainscoting, paneling, or other finish applied structurally or for decoration, acoustical correction, surface insulation, or similar purposes. Requirements for finishes shall not apply to trim, doors, windows or their frames, nor to materials which are less than one twenty-eighth inch (0.036") in thickness cemented to the surface of walls or ceilings, if these materials have flame-spread characteristics no greater than paper of this thickness cemented to an incombustible backing.

**Testing and  
Classification  
of Materials**

**Sec. 4202. (a) Testing.** Flame-spread characteristics of materials used for interior wall or ceiling finish shall be determined by one of the following methods:

1. The "Tunnel Test" as set forth in U.B.C. Standard No. 42-1.

2. The "Federal Standard Test" as set forth in U.B.C. Standard No. 42-2.

Combustible materials shall be subjected to a five-minute test in accordance with Test F-3C (2-5) of the above specifications. If the flame does not reach the angle frame at any point during a five-minute test period, the material shall be considered as combustible material.

3. Any other recognized method of test procedure for determining the flame-spread characteristics of finish materials that will give comparable results.

**(b) Application of Terms.** The terms "fire-retardant," "slow-burning," and "combustible" as used herein apply only to finish materials as specified in this Chapter.

**(c) Classification.** Three classes of interior-finish materials based upon their flame-spread characteristics under the "Tunnel Test" and the "Federal Standard Test" shall be as set forth in Table No. 42-A.

**Application  
of Controlled  
Interior  
Finish**

**Sec. 4203.** Where interior-finish materials applied to walls and ceilings are regulated for purposes of limiting flame-spread, the following provisions shall apply:

1. Ceiling and wall finishes shall be cemented or otherwise fastened in place in such a manner that they will not readily become detached when subjected to room temperatures of 400 degrees Fahrenheit for 30 minutes.

**TABLE NO. 42-A—FLAME-SPREAD CLASSIFICATION**

| Material Qualified by: |             |                       |
|------------------------|-------------|-----------------------|
| CLASS                  | TUNNEL TEST | FEDERAL STANDARD TEST |
| I                      | 0- 30       | Fire-Retardant        |
| II                     | 31- 75      | Slow-Burning          |
| III                    | 76-250      | Combustible           |

**TABLE NO. 42-B—MINIMUM INTERIOR-FINISH CLASSIFICATIONS**

| OCCUPANCY GROUP | ENCLOSED VERTICAL EXITWAYS | OTHER EXITWAYS | ROOMS OR AREAS |
|-----------------|----------------------------|----------------|----------------|
| A               | I                          | II             | III            |
| B               | I                          | II             | III            |
| C               | I                          | II             | III            |
| D               | I                          | II             | II*            |
| E               | I                          | II             | III**          |
| F               | I                          | II             | III            |
| G               | I                          | II             | III            |
| H               | I                          | II             | III**          |
| I               | No Restrictions            |                |                |
| J               | No Restrictions            |                |                |

\*Over two stories shall be of Class II.

\*\*In rooms in which personal liberties of inmates are forcibly restrained, Class I material only may be used.

2. Any finish material applied to walls or ceilings, which are required to be incombustible or fire resistive by any provision of this Code, shall be applied directly against such incombustible or fire-resistive surfaces, or to furring strips not exceeding one and three-fourths inches (1¾") applied directly to such incombustible or fire-resistive surfaces where the intervening spaces are filled with an incombustible material or are firestopped not to exceed eight feet (8') in any direction.

**Application  
of Controlled  
Interior  
Finish  
(Cont'd.)**

3. Where walls and ceilings are required to be of incombustible or fire-resistive construction and walls are set out or ceilings are dropped distances greater than as specified in paragraph 2 of this Section, incombustible materials shall be used except where the finish materials are protected on both sides by automatic fire-extinguishing systems or are attached to an incombustible backing or to furring strips installed as specified in paragraph 2, applied directly

to an incombustible backing so provided and installed as to control fire draft in any concealed spaces.

4. Wall and ceiling finish materials of all classes as permitted in this Chapter may be installed directly against the wood decking or planking of Heavy-Timber Construction or to wood furring strips applied directly to the wood decking or planking installed and firestopped as specified in paragraph 2.

5. All interior wall or ceiling finish other than Class I material which is less than one-fourth inch ( $\frac{1}{4}$ " ) thick shall be applied directly against an incombustible backing unless the qualifying tests were made with the material suspended from the incombustible backing.

**Finishes  
Based on  
Occupancy**

**Sec. 4204.** The minimum flame-spread classification of interior finish, as determined by tests, shall be based on use or occupancy as set forth in Table No. 42-B.

**EXCEPTIONS:** 1. Except in Group D occupancy and in enclosed vertical exitways, Class III may be used in other exitways and rooms as wainscoting extending not more than forty-eight inches (48") above the floor and for tack and bulletin boards covering not more than 5 per cent of the wall area.

2. Where approved full fire-extinguishing system protection is provided, the flame-spread classification rating may be reduced one classification, but in no case shall materials having a classification greater than Class III be used.

3. The exposed faces of Type III-H.T., structural members and Type III-H.T., decking and planking, where otherwise permissible under this Code are excluded from flame-spread requirements.

**CHAPTER 43—FIRE-RESISTIVE STANDARDS**

**Sec. 4301.** In addition to all the other requirements of this Code, fire-resistive materials shall meet the requirements for fire-resistive construction given in this Chapter. **General**

**Sec. 4302.** (a) **General.** Materials used for fire-resistive purposes shall be limited to those specified in this Chapter unless accepted under the procedure given in Section 4302 (b), and shall conform to the following standards: **Fire-Resistive Materials**

| MATERIALS AND TESTS  | U.B.C.<br>DESIGNATION |
|--|-----------------------|
| <b>Gypsum Lath</b> .....   | <b>47-5</b>           |
| <b>Plaster</b>   |                       |
| Gypsum .....   | <b>47-2</b>           |
| Portland Cement .....  | <b>26-1</b>           |
| <b>Fire Tests of Building Construction<br/>    and Materials</b> .....           | <b>43-1</b>           |
| <b>Fire Tests of Door Assemblies</b> .....                                       | <b>43-2</b>           |
| <b>Tin-Clad Fire Doors and Shutters</b> .....                                    | <b>43-3</b>           |
| <b>Protection of Openings in Walls and<br/>    Partitions against Fire</b> ..... | <b>43-4</b>           |

(b) **Tests.** For the purpose of determining the degree of fire resistance afforded, the materials of construction listed in this Chapter shall be assumed to have the fire-resistance ratings indicated. Any material or assembly of materials of construction tested in accordance with the requirements set forth in U.B.C. Standard No. 43-1 shall be rated for fire resistance in accordance with the results of such tests, provided that it also meets the performance standards as specified in Section 105.

(c) **Lath.** Gypsum lath shall be not less than three-eighths inch ( $\frac{3}{8}$ " ) in thickness and shall be perforated with holes not less than three-fourths inch ( $\frac{3}{4}$ " ) in diameter, except where plain gypsum lath is called for. Perforated gypsum lath shall have one hole for not more than each sixteen square inches (16 sq. in.) of lath surface. Application shall be as specified in Section 4703.

(d) **Plaster.** Plaster shall be gypsum or portland cement plaster not less than one-half inch ( $\frac{1}{2}$ " ) thick and shall conform to Chapter 47.

(e) **Concrete.** Grade A concrete is concrete in which at least 60 per cent of the coarse aggregate consists of pumice, limestone, calcareous gravel, trap rock, blast furnace slag, or burned clay or shale.

Grade B concrete is concrete in which at least 60 per cent of the coarse aggregate consists of granite, sandstone,

**TABLE NO. 43-A—MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR  
VARIOUS INCOMBUSTIBLE INSULATING MATERIALS**

Table No. 43-A

UNIFORM BUILDING CODE

| STRUCTURAL PARTS TO<br>BE PROTECTED  | INSULATING MATERIAL<br>USED   | MINIMUM THICKNESS OF MATERIAL<br>FOR THE FOLLOWING FIRE-<br>RESISTIVE PERIODS (INCHES) |               |       |       |
|--|---|--|---------------|-------|-------|
|  |   | 4 hr.  | 3 hr.         | 2 hr. | 1 hr. |
| Steel or Cast-Iron Columns;<br>Projecting Steel Beam or Gir-<br>der Flanges; All Members of<br>Primary Trusses | Grade A concrete  | 2  | 2             | 1½    | 1     |
|  | Grade B concrete  | 2½   | 2             | 1½    | 1½    |
|  | Grade C concrete  | 3  | 2½            | 2     | 1½    |
|  | Brick of clay, shale, concrete or sand-<br>lime   | 3¾   | 3¾            | 2¼    | 1¼    |
|  | Clay tile, clay tile and concrete or con-<br>crete block <sup>1, 2</sup>  | 4 or<br>2 pl.  | 4 or<br>2 pl. | 2     | 2     |
|  | Solid gypsum blocks <sup>1, 2</sup>   | 2 pl.  | 2 pl.         | 2     | 2     |
|  | Hollow gypsum blocks <sup>1, 2</sup>  | 3 pl.  | 3             | 2     | 2     |
|  | Poured gypsum   | 2  | 1½            | 1     | 1     |
|  | Metal lath and portland cement plaster  |  |               | 2¾ *  | 1     |
|  | Metal lath and gypsum plaster   |  |               | 2¼ *  | ¾     |
|  | Two ½" layers plain long-length gyp-<br>sum lath*** wrapped with wire net-<br>ting. Thickness gypsum-vermiculite<br>plaster | 1½   | 1             |       |       |
|  | One ¾" perforated gypsum lath*** no<br>netting. Thickness gypsum-vermiculite<br>plaster                                     |  |               | 1     |       |

Notes: <sup>1</sup>pl. in Table 43-A shall not be less than ½" gypsum or cement plaster.

<sup>2</sup>Reentrant parts of protected members shall be filled solid for 4 and 3 hour protections.

<sup>3</sup>Wire fabric, 1" mesh 20-gauge wire, wrapped around the lath.

<sup>4</sup>Wire fabric, 1" mesh 20-gauge wire, between the two coats of plaster.

\*Two layers with ¾" air space between.

\*\*Thickness required for column protection. Lath spaced 1¼" from column. Space behind lath on flange faces filled with plaster.

†¾" of gypsum-vermiculite plaster plus ½" of vermiculite acoustical plaster may be used.

‡Thickness includes gypsum or cement plaster.

\*\*\*Lath applied tight against column flanges.



TABLE NO. 43-A (Continued)

| STRUCTURAL PARTS TO<br>BE PROTECTED  | INSULATING MATERIAL<br>USED   | MINIMUM THICKNESS OF MATERIAL<br>FOR THE FOLLOWING FIRE-<br>RESISTIVE PERIODS (INCHES) |          |       |       |
|--|---|--|----------|-------|-------|
|  |   | 4 hr.  | 3 hr.    | 2 hr. | 1 hr. |
| Steel or Cast-Iron Columns;<br>Projecting Steel Beam or Gir-<br>der Flanges; All Members of<br>Primary Trusses | Metal lath and gypsum-vermiculite<br>plaster  | 1½**<br>1†   | 1**<br>¾ | ¾     | ¾     |
|  | Approved perlite-gypsum plaster over<br>self-furring metal lath wrapped direct-<br>ly around column                                 | 1¾   | 1⅝       | 1     |       |
|  | Approved perlite-gypsum plaster over<br>metal lath furred 7/16" from column<br>with ¾" channel brackets at 2' ver-<br>tical spacing | 1½   |          |       |       |
|  | Gypsum-vermiculite plaster over self-<br>furring metal lath wrapped directly<br>around column                                       | 1¾   |          |       |       |
|  | Plain long-length gypsum lath, two<br>layers, ½"****. Vermiculite or ap-<br>proved perlite-gypsum plaster                           | 1½   | 1        |       |       |
|  | Plain long-length gypsum lath, ½",<br>one layer****. Vermiculite or approved<br>perlite-gypsum plaster                              |  | 1½       |       |       |
|  | Perforated gypsum lath, ⅝"****. Ver-<br>miculite or approved perlite-gypsum<br>plaster  |  | 1⅝       | 1     |       |
|  | Perforated gypsum lath, ⅝"****. Gyp-<br>sum sanded plaster  |  |          |       | ½     |

See footnotes page 268.

TABLE NO. 43-A (Continued)

Table No. 43-A

UNIFORM BUILDING CODE

| STRUCTURAL PARTS TO BE PROTECTED   | INSULATING MATERIAL USED  | MINIMUM THICKNESS OF MATERIAL FOR THE FOLLOWING FIRE-RESISTIVE PERIODS (INCHES) |       |       |       |
|--|---|---|-------|-------|-------|
|  |   | 4 hr.   | 3 hr. | 2 hr. | 1 hr. |
| Webs of Steel Beams and Girders  | Grade A concrete  | 2   | 1½    | 1     | 1     |
|  | Grade B concrete  | 2½  | 2     | 1½    | 1     |
|  | Grade C concrete  | 3   | 2½    | 1½    | 1     |
|  | Brick of clay, shale, concrete or sand-lime   | 3¾  | 2¼    | 2¼    | 2¼    |
|  | Clay tile, clay tile and concrete or concrete block                                       | 3 or 2 pl.  | 2     | 2     | 2     |
|  | Solid gypsum block  | 2 pl.   | 2     | 2     | 2     |
|  | Hollow gypsum block   | 3 pl.   | 2     | 2     | 2     |
|  | Poured gypsum   | 2   | 1½    | 1     | 1     |
|  | Metal lath and gypsum-vermiculite plaster   | 1†  | ¾     | ¾     | ¾     |
|  | Metal lath and gypsum or portland cement plaster  |   |       | 2     | ¾     |
| Reinforcing Steel in Reinforced Concrete Columns, Beams, Girders and Trusses                 | Grade A or B concrete   | 1½  | 1½    | 1½    | 1     |
|  | Grade C concrete  | 2   | 1½    | 1½    | 1     |
|  | Grade A or B concrete   | 1¼  | 1¼    | 1     | ¾     |
| Reinforcing Steel in Reinforced Concrete Joists  | Grade C concrete  | 1¾  | 1½    | 1     | ¾     |
|  | Metal or wire lath and gypsum or cement plaster, concrete, burned clay products or gypsum | 2   | 1½    | 1     | ¾     |
| Ceiling Protection for Steel Roof Members Including Steel Roof Trusses and Secondary Trusses | Metal lath and gypsum-vermiculite plaster   | 1†  | ¾     | ¾     | ¾     |
|  | Grade A or B concrete‡  | 1   | 1     | ¾     | ¾     |
| Reinforcing and Tie Rods in Floor and Roof Slabs   | Grade C concrete‡   | 1¼  | 1     | 1     | ¾     |
|  | Gypsum‡   | 1   | 1     | ¾     | ¾     |

See footnotes page 268.

cinders, or a mixture of any of these aggregates with aggregates for Grade A concrete.

Grade C concrete is any concrete not classed as Grade A or B.

**Fire-Resistive Materials (Cont'd.)**

Where the classification is in doubt, concrete shall be assumed to be Grade C unless tests on the aggregates by an approved agency prove otherwise.

(f) **Pneumatically Placed Concrete.** Pneumatically placed concrete without coarse aggregate shall be classified as Grade A, B, or C concrete in accordance with the aggregate used.

**Sec. 4303. (a) Protective Coverings. 1. Thickness of protection.** The thickness of fire-resistive materials for protection of structural members shall be not less than that set forth in Table No. 43-A, except as modified in this Section. The figures shown shall be the net thickness of the protecting materials and shall not include any hollow space back of the protection.

**Protection of Structural Members**

**2. Unit masonry protection.** Unit masonry protection for metal columns shall have metal ties embedded in each transverse joint, where joints are more than sixteen inches (16") apart, and shall be spaced not more than sixteen inches (16") in other cases. Soffit tile protecting beam and girder flanges shall be tied to the flange. Ties shall have a cross-sectional area equal to that of No. 8 gauge wire.

**3. Reinforcement for cast-in-place protection.** Cast-in-place protection for metal structural members shall be reinforced at the edges of such members with wire or mesh with a maximum spacing of six inches (6") wound around or attached to the member. The sum of the cross-sectional area in each direction shall be not less than 0.025 square inches per foot.

**4. Embedment of pipes.** Conduits and pipes shall not be embedded in required fire protection of structural members.

**5. Column jacketing.** Where the fire-resistive covering on columns is exposed to injury from moving vehicles, the handling of merchandise, or by other means, it shall be jacketed to a minimum height of six feet (6') from the floor with an adequate protective covering.

**6. Ceiling protection.** Where a ceiling is used to fire protect floors or roofs of incombustible construction, the constructions and their supporting structural members (beams and girders) need not be individually fire protected except where such members support loads from more than one floor or roof. Ceilings shall be continuous, but may have openings for incombustible pipes, ducts, and electrical outlets, provided the areas of such duct and outlet openings through the ceiling aggregate not more than one hundred square inches (100 sq. in.) in each one hundred square feet (100 sq. ft.) of ceiling area. All duct openings in such ceiling shall be protected by approved fire dampers.

TABLE NO. 43-B—RATED FIRE-RESISTIVE PERIODS FOR VARIOUS WALLS AND PARTITIONS

| MATERIAL  | CONSTRUCTION   | Minimum Finished Thickness<br>face to face (including plaster<br>where mentioned) in inches |       |       |            |
|---|--|---|-------|-------|------------|
|   |  | 4-hr.   | 3-hr. | 2-hr. | 1-hr.      |
| Brick of Clay, Shale,<br>Sand-Lime or<br>Concrete, and<br>Plain Concrete  | Solid unplastered  | 8   |       |       | 4*         |
|   | Solid plastered  | 9   |       | 5*    |            |
|   | Hollow (rowlock) unplastered   | 12  | 10    | 8     |            |
|   | Hollow (rowlock) plastered   | 9   |       |       |            |
| Hollow<br>Clay<br>Tile,<br>Wall   | End or side construction. One cell in wall thickness.<br>Plastered                   |   |       |       | 3*         |
|   | End or side construction. Two cells in 8" or less thickness.<br>Unplastered          | 16  | 12    |       | 6*<br>or 8 |
|   | End or side construction. Two cells in 8" or less thickness.<br>Plastered            | 13  | 9     | 7*    |            |
|   | End or side construction. Two cells in wall thickness.<br>Unplastered                |   |       | 6     |            |
| Hollow<br>Clay<br>Tile,<br>Load<br>Bearing<br>(U. B. C.<br>Standard 24-8)   | End or side construction. Two cells in wall thickness.<br>Plastered                  |   |       | 5*    |            |
|   | End or side construction. Three cells in 8" or less thickness.<br>Unplastered        | 12  |       |       |            |
|   | End or side construction. Three cells in 8" or less thickness.<br>Plastered one side |   | 8½    |       |            |
|   | End or side construction. Three cells in 8" or less thickness.<br>Plastered          | 9   |       |       |            |
|   | 4" brick and 4" tile. Plastered one side (tile side)                                 | 9   |       |       |            |
| Combination of Brick<br>and Load-Bearing Tile.<br>(U. B. C. Standard 24-8)<br>or Hollow Concrete<br>Block or Tile |  |   |       |       |            |

\*Shall be used for non-bearing purposes only.

\*\*8" for Expanded Slag.

\*\*\*Mineral or slag wool bats shall weigh not less than 1.0 lb. and glass wool bats not less than 0.6 lb. per sq. ft. of wall surface.

†¾" Face Shells.

††One part gypsum to one part sand by weight for scratch coat and one part gypsum to two parts sand by weight for brown coat.

TABLE NO. 43-B (Continued)

| MATERIAL  | CONSTRUCTION  |                 | Minimum Finished Thickness face to face (including plaster where mentioned) in inches |       |       |       |
|---|---|-----------------|---|-------|-------|-------|
|   |   |                 | 4-hr.   | 3-hr. | 2-hr. | 1-hr. |
| Concrete Block or Tile                                  | Aggregate—Expanded Slag, Burned Clay or Shale, Cinders  | 1½" face Shells | Unplastered   |       | 8     | 4†    |
|   |   | 1½" face Shells | Plastered one side  | 8½    | 4½†   |       |
|   |   | 2¼" face Shells | Unplastered   | 12**  | 8     |       |
|   |   | 2¼" face Shells | Plastered each side   | 9     |       |       |
|   | Other Aggregates—   | 1¾" face Shells | Unplastered   |       | 8     | 4†    |
|   |   | 1¾" face Shells | Plastered each side   | 9     | 5†    |       |
|   |   | 1¾" face Shells | Unplastered   | 12    | 8     |       |
|   |   | 2¼" face Shells | Plastered each side   | 9     |       |       |
|   |   | 2¼" face Shells | Unplastered   | 8     |       |       |
|   |   |                 |   |       |       |       |
| Solid Concrete  | Reinforcement not less than 0.2% in each direction  |                 | 6   | 5     | 4     | 2*    |
| Hollow Gypsum Blocks                                    | Unplastered   |                 | 6*  | 5*    | 4*    | 3*    |
|   | Plastered each side   |                 | 5*  | 4*    | 4*    | 3*    |
| Hollow Wall of Reinforced Pneumatically Placed Concrete | Outer shell 2" thick for 10" wall and 1½" thick for 8" wall   |                 | 10*   | 8*    |       |       |
| Solid Gypsum or Portland Cement Plaster                 | Incombustible studding with metal or wire lath  |                 |   |       |       | 2*    |
|   | Incombustible studding with metal or wire lath, neat wood fiber gypsum plaster  |                 |   |       | 2*    |       |
|   | Studless partition, incombustible runners, ¾" or ½" plain gypsum lath, gypsum plaster†† each side                         |                 |   |       |       | 2*    |
|   | Incombustible studding with metal or wire lath, vermiculite or approved perlite gypsum plaster                            |                 |   |       | 2½*   | 2*    |
|   | Studless partition, incombustible runners, ½" plain gypsum-lath, vermiculite or approved perlite gypsum plaster each side |                 |   |       | 2½*   | 2*    |
|   | Studless partition with diamond mesh or ¾" rib lath, gypsum sanded plaster  |                 |   |       |       | 2*    |

See footnotes page 272.

TABLE NO. 43-B (Continued)

| MATERIAL   | CONSTRUCTION  | Minimum Finished Thickness<br>face to face (including plaster<br>where mentioned) in inches |       |       |            |
|--|---|---|-------|-------|------------|
|  |   | 4-hr.   | 3-hr. | 2-hr. | 1-hr.      |
| Hollow Stud<br>Partition with<br>Gypsum or<br>Portland Cement<br>Plaster on each Side<br>or Gypsum Wallboard | Incombustible studding with metal or wire lath, $\frac{3}{4}$ " plaster on each side  |   |       |       | 3          |
|  | Incombustible studding with metal or wire lath, 1" plaster on each side   |   |       | 4½    |            |
|  | Wood studs with metal or wire lath. Fire-stopped. $\frac{3}{4}$ " plaster on each side  |   |       |       | 3*<br>or 5 |
|  | Wood studs with metal or wire lath. Fire-stopped. 1" neat wood fiber plaster each side  |   |       | 5*    |            |
|  | Wood studs with $\frac{3}{8}$ " perforated gypsum lath. Fire-stopped. $\frac{1}{2}$ " gypsum plaster each side  |   |       |       | 3*<br>or 5 |
|  | Wood studs with space between filled with mineral wool bats *** nailed to studs, $\frac{1}{2}$ " gypsum wallboard each side   |   |       |       | 4½         |
|  | Wood studs with two layers of $\frac{1}{2}$ " gypsum wallboard each side, joints staggered  |   |       |       | 5½         |
|  | Exterior—Drop siding over $\frac{1}{2}$ " gypsum sheathing. Interior— $\frac{1}{2}$ " gypsum plaster over $\frac{3}{8}$ " perforated gypsum lath  |   |       |       | 5%         |
| Wood Stud<br>Wall  | Exterior—Drop siding over $\frac{1}{2}$ " gypsum sheathing. Interior—two thicknesses of $\frac{1}{2}$ " gypsum wallboard  |   |       |       | 5¾         |
| Glazed or<br>Unglazed<br>Facing<br>Tile<br>(Non-Bearing)   | Cored not in excess of 25%, 2 units in wall thickness with mortar filled collar joint   |   | 6*    |       |            |
|  | Two inches cored not in excess of 25% and 4 inches structural tile, cored not in excess of 40%, collar joint mortar filled, plastered on one side with $\frac{3}{4}$ " gypsum-sand plaster                                      |   | 6*    |       |            |
|  | Cored not in excess of 25%, plastered with $\frac{3}{4}$ " gypsum-sand plaster  |   |       | 4*    |            |
|  | Cored not in excess of 30%, plastered with $\frac{3}{4}$ " vermiculite plaster  |   |       | 4*    |            |
|  | Meeting requirements of U.B.C. Standard No. 24-9, except that shells of solid shell horizontal cell units shall be not less than $\frac{3}{4}$ " thick, plastered with $\frac{3}{4}$ " gypsum-sand and plaster —(1:3 by volume) |   |       |       | 4*         |

See footnotes page 272.

(b) **Protected Members.** 1. **Attached metal members.** The edges of lugs, brackets, rivets, and bolt heads attached to structural members may extend to within one inch (1") of the surface of the fire protection.

**Protection of  
Structural  
Members  
(Cont'd.)**

2. **Reinforcing.** Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement, except that stirrups and ties may project not more than one-half inch ( $\frac{1}{2}$ ") into the protection.

3. **Steel studs and joists.** Steel studs and joists are not required to have individual protection when part of an assembly which has a fire-resistive rating.

(c) **Fire Protection Omitted.** Fire protection may be omitted from the bottom flange of lintels, shelf angles, or plates that are not a part of the structural frame.

**Sec. 4304. (a) General.** Fire-resistive walls and partitions shall have the ratings set forth in Table No. 43-B.

**Walls and  
Partitions**

(b) **Combustible Members.** Combustible members framed into a wall shall be protected at their ends by not less than one-half the required fire-resistive thickness of such wall.

**Sec. 4305. (a) General.** Fire-resistive floors or ceilings shall have the ratings set forth in Table No. 43-C.

**Floors  
and Ceilings**

(b) **Ceilings.** Where a ceiling of lath and plaster as approved for one-hour fire-resistive construction as specified in this Chapter is used below slabs or structural members not otherwise required to be protected by such a ceiling, the required thickness of slab and fire protection of structural members may be reduced one-half inch ( $\frac{1}{2}$ ") but in no case shall the slab thickness be less than two inches (2").

(c) **Unusable Space Above or Below.** In one-hour fire-resistive construction the ceiling may be omitted over unusable space and flooring may be omitted where unusable space occurs above.

**Sec. 4306. (a) Where Required.** Class "A" fire doors shall be installed when required in Sections 503 (c), 505 (c), and 3904.

**Fire-Resistive  
Assemblies for  
Protection  
of Openings**

Class "B" fire doors shall be installed when required in Sections 503 (c), 1706 (a), 3305 (e), 3308 (c), and 3309 (e).

Class "C" fire doors shall be installed when required in Sections 503 (c), 1308, 3304 (g), and 4003.

Class "D" fire doors shall be installed when required in Section 505 (c).

Class "E" or "F" fire doors shall be installed when required in Sections 608, 708, 808, 1008, 1706 (a), 1803 (b), 1903 (b), 2003 (b), 3305 (h), 3308 (c), and 3311 (d).

Fire doors and windows are not required in fire-resistive walls or partitions unless specified elsewhere in this Code.

TABLE NO. 43-C—MINIMUM PROTECTION FOR FLOOR AND ROOF SYSTEMS

| MATERIAL   | CONSTRUCTION  | MINIMUM THICKNESS OF FLOOR OR ROOF SLAB (Inches) |       |       |       | MINIMUM THICKNESS OF CEILING (Inches) |       |       |       |
|--|---|--|-------|-------|-------|---------------------------------------|-------|-------|-------|
|  |   | 4 hr.  | 3 hr. | 2 hr. | 1 hr. | 4 hr.                                 | 3 hr. | 2 hr. | 1 hr. |
| Concrete   | Slab or arch (no ceiling required)  | 6½   | 5½    | 4½    | 3½    |                                       |       |       |       |
| Solid masonry or gypsum  | Slab or arch (no ceiling required)  | 4  | 3     | 2½    | 2½    |                                       |       |       |       |
| Hollow masonry   | Slab or arch  | 4¹   | 3½¹   | 3¹    | 3     |                                       |       |       |       |
| Reinforced concrete joists   | Slab with suspended ceiling on metal or wire, lath gypsum or portland cement plaster²             |  |       | 2½    | 2     |                                       |       | ¾     | ¾     |
|  | Slab (no ceiling required)  |  |       |       | 3     |                                       |       |       |       |
|  | Concrete or gypsum slab with Ceiling, gypsum plaster  | 2½   | 2½    | 2¼    | 2     | 2                                     | 1³    | ¾     | ¾     |
| Steel joist or light steel construction, with attached or suspended ceiling of metal or wire lath  | Concrete or gypsum slab with Ceiling, gypsum vermiculite plaster                                  | 2½   | 2½    | 2     | 2     | 1⁴                                    | ¾     | ¾     | ¾     |
|  | Concrete or gypsum slab with Ceiling, portland cement plaster²                                    |  |       |       | 2     |                                       |       |       | ¾     |
|  | T. & G. wood flooring on wood stripping with Ceiling, gypsum plaster                              |  |       |       | 1 nom |                                       |       |       | ¾     |
|  | CONCRETE OR GYPSUM SLAB 2" in thickness when ceiling is one of the five ceilings specified below  |  |       |       |       |                                       |       |       |       |
|  | Ceiling, ⅝" plaster, ¾" channels 16" on center  |  |       |       | 2     |                                       |       |       | 1     |
| Steel joist or light steel construction, with attached or suspended ceiling of ⅝" perforated gypsum lath attached with clips giving continuous support to lath and plastered with vermiculite or approved perlite-gypsum plaster | Ceiling, ½" plaster, ¾" channels 16" on center, 14-gauge diagonal wire⁵                           |  |       | 2     |       |                                       |       | ¾     |       |
|  | Ceiling, ½" plaster, ¾" channels 16" on center, plaster reinforcement with 20-gauge 1" wire mesh⁶ | 2  |       |       |       |                                       | ¾     |       |       |
|  |   |  |       |       |       |                                       |       |       |       |



TABLE NO. 43-C (Continued)

|  |  | 2    | 1                           |
|--|--|------|-----------------------------|
| Steel joist or light steel construction, etc. (cont'd.)  | Ceiling, $\frac{5}{8}$ " plaster, $\frac{3}{4}$ " channels 12" on center, 14-gauge diagonal wire <sup>5</sup>                              |      |                             |
|  | Ceiling, 1" plaster, $\frac{3}{4}$ " channels 12" on center, plaster reinforcement with 20-gauge 1" wire mesh <sup>6</sup>                 | 2    | 1%                          |
| Steel roof deck on steel framing with suspended ceiling of metal or wire lath  | Fiberboard insulation or wood fiber and cement binder on top of deck, with Ceiling, gypsum plaster sanded 1:2                              | 1½ 1 | $\frac{7}{8}$ $\frac{3}{4}$ |
|  | Wood sheathing or fiberboard insulation on top of deck, with Ceiling, gypsum or portland cement plaster <sup>2</sup>                       | 1    | $\frac{3}{4}$               |
| Steel or precast concrete joists with attached or suspended ceiling of metal or wire lath  | Double wood floor with building paper between, with Ceiling, gypsum or portland cement plaster <sup>2</sup>                                | 1½   | $\frac{3}{4}$               |
|  | Attached ceiling of gypsum lath <sup>1</sup> and gypsum plaster sanded 1:2   |      | $\frac{7}{8}$               |
| Wood joists with sub-floor of 1" nom. boarding or $\frac{5}{8}$ " plywood, a layer of building paper and $\frac{1}{2}$ " T. & G. flooring. | Attached ceiling of gypsum lath and gypsum-vermiculite or approved perlite plaster   |      | $\frac{7}{8}$               |
|  | Attached or suspended ceiling of metal lath and gypsum or portland cement plaster <sup>2</sup>   |      | $\frac{3}{4}$               |
|  | Attached ceiling of metal lath and vermiculite-gypsum plaster  |      | $\frac{3}{4}$               |
|  | Attached ceiling of two layers of $\frac{1}{2}$ " gypsum wallboard with a separately attached 20-gauge 1" wire mesh between the two layers |      | 1                           |

Notes: <sup>1</sup>Requires top covering of solid masonry equal to  $\frac{1}{2}$  thickness of slab or arch.

<sup>2</sup>Portland cement plaster with 15 pounds of hydrated lime and 3 pounds of asbestos fiber per bag of portland cement.

<sup>3</sup>Neat wood fiber gypsum plaster.

<sup>4</sup>Five-eighths inch of vermiculite-gypsum plus  $\frac{1}{2}$ " of vermiculite acoustical plaster may also be used.

<sup>5</sup>14-gauge galvanized wire secured diagonally to clips or channels at each intersection.

<sup>6</sup>Wire mesh tied to each furring channel at joint, between adjacent lath.

<sup>7</sup>All joints reinforced with 3" strips of metal lath.

**Fire-Resistive  
Assemblies for  
Protection  
of Openings  
(Cont'd.)**

(b) **Scope.** Fire doors and windows wherever specified in this Code shall meet the requirements of this Section.

(c) **Classification of Openings.** Openings requiring fire doors or windows shall be classified as follows:

"Class 'A' openings" are openings in "Three-Hour Fire-Resistive Occupancy Separations."

"Class 'B' openings" are openings in "Two-Hour Fire-Resistive Occupancy Separations" and in enclosures to vertical shafts.

"Class 'C' openings" are openings in "One-Hour Fire-Resistive Occupancy Separations"; corridor walls which are required to be of one-hour fire-resistive construction; and room partitions. See Section 3304 (g) for openings in corridor walls.

"Class 'D,' 'E,' and 'F' openings" are in exterior walls which have severe, moderate, or light fire exposure, respectively.

(d) **Class "A" Openings.** Class "A" openings shall be protected by two automatic Class "A" fire doors, one on each side of the opening and interconnected.

Each Class "A" fire door shall have a fire-resistance time period of three hours and shall be without glazed openings.

(e) **Class "B" Openings.** Class "B" openings shall be protected by one automatic or self-closing Class "B" fire door.

A Class "B" fire door shall have a fire-resistance time period of one and one-half hours.

Glass panels in a Class "B" fire door shall be limited to one observation panel not exceeding twelve inches (12") in width or height and one hundred square inches (100 sq. in.) in area. Where doors are hung on each jamb of a Class "B" opening, an observation panel may be installed in each of the two doors.

(f) **Class "C" Openings.** Class "C" openings shall be protected by one self-closing Class "C" fire door.

A Class "C" fire door shall have a fire-resistance time period of one hour, except that doors with glass panels larger than one hundred square inches (100 sq. in.) may have a fire-resistance time period of 45 minutes.

Individual glass lights in glazed openings shall be limited in area to twelve hundred and ninety-six square inches (1296 sq. in.).

(g) **Class "D" Openings.** Class "D" openings shall be protected by one automatic closing Class "D" fire door.

Class "D" fire doors shall have a fire-resistance time period of one and one-half hours and shall have no glazed openings.

(h) **Class "E" and "F" Openings.** Class "E" and "F" openings shall be protected by a Class "E" or "F" fire door or fire window. Self-closing devices shall not be required.

Class "E" and "F" fire doors and fire windows shall have a fire-resistance time period of 45 minutes.

Individual glass lights shall be limited to fifty-four inches (54") in height, forty-eight inches (48") in width, and seven hundred and twenty square inches (720 sq. in.) in area.

Class "E" and "F" fire windows shall be limited in area to eighty-four square feet (84 sq. ft.) with neither width nor height exceeding twelve feet (12').

Double-hung fire windows shall be not more than six feet (6') wide nor more than twelve feet (12') high.

(i) **Glass.** Glass used in fire doors or fire windows shall be not less than one-fourth inch ( $\frac{1}{4}$ " ) thick and shall be reinforced with wire mesh, 24 gauge or heavier, with openings not larger than one inch (1") square.

Glass shall be held in place by metal glazing angles, except that in casement windows wire clips may be used.

(j) **Closing Devices.** Automatic fire doors shall be designed to close automatically when the temperature of a heat-actuated device reaches 165 degrees Fahrenheit or 50 degrees above maximum room temperature under normal conditions. Heat-actuated devices shall be installed, one on each side of the wall at the top of the opening and one on each side of the wall at ceiling height where the ceiling is more than three feet (3') above the opening.

Interconnected doors shall be designed so that both doors will close automatically by the action of any of the heat-actuated devices.

Self-closing doors shall be designed to close by gravity or by the action of a mechanical device. Self-closing doors shall have no attachments capable of preventing the operation of the closing devices.

(k) **Fire-Resistance Tests.** The fire-resistance time rating of every type of required fire protection assembly shall be determined in the manner set forth in U.B.C. Standard No. 43-2. A minimum transmitted temperature end point shall not be required.

(l) **Label.** Every fire door and fire window shall bear the label or other identification of an approved testing agency showing the classification thereof. The following labels of the Underwriters' Laboratories, Inc., shall be approved labels within the meaning of this Section:

Label marked "Fire Door for Opening in Fire Wall" shall be approved for Class "A" fire doors.

Label marked "Fire Door for Opening in Vertical Shaft" shall be approved for Class "B" fire doors.

Label marked "Fire Door for Opening in Corridor or Room Partition" shall be approved for Class "C" fire doors.

Label marked "Fire Door for Opening in Exterior Wall" shall be approved for Class "D," "E," and "F" fire doors.

Label marked "Fire Window Frame for Light Exposures" shall be an approved label for fire windows when glazed with wired glass conforming to Subsection (i).

**EXCEPTION:** Unlabeled passenger elevator hoistway doors may be installed if the panels are of equivalent fire resistance.

**Fire-Resistive  
Assemblies for  
Protection  
of Openings  
(Cont'd.)**

(m) **Tin-Clad Doors.** If constructed as set forth in U.B.C. Standard No. 43-3, tin-clad fire doors shall be considered as meeting the requirements of this Section, provided each door bears the label of an approved inspection agency showing the classification thereof.

(n) **Installation.** Fire doors and fire windows shall be installed as set forth in U.B.C. Standard No. 43-4.

(o) **Signs.** A sign or plaque shall be permanently displayed near or on each required fire door in letters not less than one inch (1") high to read as follows:

**FIRE DOOR  
DO NOT OBSTRUCT**

**Roof  
Coverings**

**Sec. 4307.** Fire-resistive roof coverings shall be as specified in Section 3203.

## PART IX

# REGULATIONS FOR USE OF PUBLIC STREETS AND PROJECTIONS OVER PUBLIC PROPERTY

### CHAPTER 44—PROTECTION OF PEDESTRIANS DURING CONSTRUCTION OR DEMOLITION

**Sec. 4401.** No person shall place or store any material or equipment necessary for the work under a building permit on a street, alley, or public sidewalk, nor shall any work be performed except in accordance with the provisions of this Chapter. **General**

No person shall perform any work on any building or structure, if by so doing he endangers pedestrians on the street that abuts the property line, unless the pedestrians are protected as specified in this Chapter.

Any material or structure temporarily occupying public property, including fences and walkways, shall be adequately lighted between sunset and sunrise.

**Sec. 4402.** Material or equipment necessary for the work under a building permit may be placed or stored on public property in the following locations: **Temporary  
Use of  
Streets and  
Alleys**

(a) **In Front of the Building Site.** In the one-third portion of the roadway of the street that is adjacent to the curb in front of the building site for which a permit has been issued; provided that no material or equipment shall be placed or stored within five feet (5') of any rail or any street railway track.

(b) **In Front of the Adjoining Site.** In the roadway of the street adjoining the building site for which a permit has been issued to the same extent and under the same restrictions as specified in Subsection (a).

A due waiver of claim against the city for damages on account of such placement or storage must be obtained from the owner of such property and filed in the office of the Building Official before such materials or equipment may be placed or stored.

(c) **In the Alley.** In the alley adjoining the building site for which a permit has been issued, provided that a clear and unobstructed roadway not less than ten feet (10') in width is maintained through such alley along the building site.

(d) **Public Sidewalk in Front of Building Site.** On any portion of the public sidewalk in front of the building site for which a permit has been issued, except on the walkway required to be maintained.

**Restrictions  
to Storage  
on Public  
Property**

**Sec. 4403.** Material and equipment necessary for work to be done under a permit shall not be placed or stored on public property so as to obstruct free and convenient approach to any fire hydrant, fire or police alarm box, utility box, catch basin, or manhole, or so as to interfere with the free flow of water in any street or alley gutter.

**Mixing Mortar  
on Public  
Property**

**Sec. 4404.** The mixing of mortar or concrete on public property shall be done in a mechanical mixer or in a tight box in such a manner as to prevent dripping or splashing on the public property.

**Protection of  
Utilities**

**Sec. 4405.** A substantial protective frame and boarding shall be built around and over every street lamp, utility box, fire or police alarm box, fire hydrant, catch basin, and manhole that may be damaged by any work being done under the permit. This protection shall be maintained while such work is being done.

**Protection of  
Pedestrians  
on Public  
Property**

**Sec. 4406. (a) Walkway.** A walkway not less than four feet (4') wide with a railing on the street side shall be maintained on the sidewalk in front of the building site during construction, alterations, or demolition.

**(b) Type of Protection Required.** Protection shall be provided for pedestrians as set forth in Table No. 44-A, and be constructed as specified in this Chapter.

Such protection shall be maintained in place and kept in good order for the entire length of time pedestrians on the street that abuts the property line may be endangered, and shall be completely removed as soon as such construction work permits.

**(c) Construction of Railings.** Railings shall be substantially built and not less than three feet (3') high.

**TABLE NO. 44-A—TYPE OF PROTECTION REQUIRED  
FOR PEDESTRIANS**

| HEIGHT OF<br>CONSTRUCTION | DISTANCE FROM<br>CONSTRUCTION TO<br>WALKWAY                              | PROTECTION<br>REQUIRED |
|---------------------------|--|------------------------|
| Eight feet or less        | Less than six feet   | Railing                |
|                           | Six feet or more   | None                   |
| More than eight feet      | Less than six feet   | Fence and Canopy       |
|                           | Six feet or more and<br>one-fourth height of<br>construction or less     | Fence and Canopy       |
|                           | Six feet or more and<br>one-fourth to one-half<br>height of construction | Fence                  |
|                           | Six feet or more and at<br>least one-half height<br>of construction      | None                   |

(d) **Construction of Fences.** Fences shall be substantially built of tight boards eight feet (8') high above grade, placed on the side of the walkway nearest to the building site. Fences shall extend the entire length of the building site and each end shall be turned and extended to the building line.

**Protection of  
Pedestrians  
on Public  
Property  
(Cont'd.)**

Doorways may be cut in the fence if they are protected by doors and kept closed, except when opened to permit materials or persons to pass through.

(e) **Construction of Canopies.** The protective canopy shall have a clear height of eight feet (8') above the walkway. The roof shall be tightly boarded. Every canopy shall have a tight board fence built along its entire length, on the side thereof next to the building site. The fence shall be solid from the sidewalk or walkway to the canopy roof and each end shall be turned and extended solid to the building site.

The entire structure shall be designed to carry the loads to be imposed on it, provided the minimum live load to be used in design shall be not less than 35 pounds per square foot, uniformly loaded.

If materials are stored or work is done on the roof of the canopy, the street sides and ends of the canopy roof shall be protected by a tight curb board not less than one foot (1') high and a railing not less than three feet (3') high.

The space under the canopy over the walkway and the approaches thereto shall be kept well lighted with artificial lighting continuously between sunset and sunrise.

**Sec. 4407.** When the area or a portion thereof occupied by a public sidewalk is to be excavated, the holder of the building permit shall construct a substantial temporary walkway not less than four feet (4') in width for pedestrian travel over the areas to be excavated or around the same.

**Protection of  
Sidewalk  
Excavations**

The walkway over the excavated area shall be designed for a uniform live load of 150 pounds per square foot. The walkway shall be provided with suitable ramps or stairs at each end and with a handrail not less than three feet (3') high along each side or with a railing on one side and a fence on the other, as the case may require.

The walkway around the excavated area shall be as close to the excavation on the street side as possible and constructed with a railing not less than three feet (3') high and a fence on the excavation side of the walkway.

**CHAPTER 45—PERMANENT OCCUPANCY OF  
PUBLIC PROPERTY****General**

**Sec. 4501.** No part of any structure or any appendage thereto, except signs, shall project beyond the property line of the building site, except as specified in this Chapter.

Structures or appendages regulated by this Code shall be constructed of materials as specified in Section 1710 and Chapter 35.

The projection of any structure or appendage shall be the distance measured horizontally from the property line to the outermost point of the projection.

**Projection  
into Alleys**

**Sec. 4502.** No part of any structure or any appendage thereto, except signs, shall project into any alley except that a curb or buffer block may project not more than nine inches (9") and not exceed a height of nine inches (9") above grade.

**Space  
below  
Sidewalk**

**Sec. 4503.** The space adjoining a building below a sidewalk on public property may be used and occupied in connection with the building for any purpose not inconsistent with this Code or other laws or ordinances regulating the use and occupancy of such spaces on condition that the right so to use and occupy may be revoked by the city at any time and that the owner of the building will construct the necessary walls and footings to separate such space from the building and pay all costs and expenses attendant therewith.

**Balconies  
and  
Appendages**

**Sec. 4504.** Oriel windows, balconies, unroofed porches, cornices, and belt courses, and appendages such as water-tables, sills, capitals, bases, and other decorative features may project over the public property of the building site a distance as determined by the clearance of the lowest point of the projection above the grade immediately below, as follows:

Clearance above grade less than eight feet (8')—no projection is permitted.

Clearance above grade over eight feet (8')—one inch (1") of projection is permitted for each additional inch of clearance, provided that no such projection shall exceed a distance of four feet (4').

**Marquees**

**Sec. 4505. (a) General.** For the purpose of this Section a marquee shall include any object or decoration attached to or a part of said marquee.

**(b) Projection and Clearance.** The horizontal clearance between a marquee and the curb line shall be not less than two feet (2').

A marquee projecting more than two-thirds of the distance from the property line to the curb line shall be not less than twelve feet (12') above the ground or pavement below.

A marquee projecting less than two-thirds of the distance



from the property line to the curb line shall be not less than eight feet (8') above the ground or pavement below. **Marquees (Cont'd.)**

(c) **Length.** A marquee projecting more than two-thirds of the distance from the property line to the curb line shall not exceed twenty-five feet (25') in length along the direction of the street.

(d) **Thickness.** The maximum height or thickness of a marquee measured vertically from its lowest to its highest point shall not exceed three feet (3') when the marquee projects more than two-thirds of the distance from the property line to the curb line and shall not exceed nine feet (9') when the marquee is less than two-thirds of the distance from the property line to the curb line.

(e) **Construction.** A marquee shall be supported entirely from the building and constructed as specified under Types of Construction and shall be of incombustible material or of not less than one-hour fire-resistive construction.

(f) **Roof Construction.** The roof or any part thereof may be a skylight, provided wire glass is used not less than one-fourth inch ( $\frac{1}{4}$ " ) thick with no single pane more than eighteen inches (18") wide.

Every roof and skylight of a marquee shall be sloped to downspouts which shall conduct any drainage from the marquee under the sidewalk to the curb.

(g) **Location Prohibited.** Every marquee shall be so located as not to interfere with the operation of any exterior standpipe or to obstruct the clear passage of stairways or exits from the building or the installation or maintenance of electroliners.

**Sec. 4506.** Movable awnings or hoods may have combustible coverings supported on incombustible frames attached to the building.

**Movable  
Awnings or  
Hoods**

Such awning or hood may extend over the public property not more than two-thirds the distance from the property line to the nearest curb in front of the building site.

The lowest part of any movable awning or hood frame shall be not less than eight feet (8') above the ground immediately below, and the lowest part of any fringe attached to such awning or hood shall be not less than seven feet (7') above the grade immediately below.

**Sec. 4507.** Doors in Fire Zones Nos. 1 and 2, either fully opened or when opening, shall not project more than one foot (1') beyond the property line, except that in alleys no projection beyond the property line is permitted. Doors in Fire Zone No. 3, that swing over the property line, shall be maintained normally closed.

**Doors**

## PART X

## PLASTERING

## CHAPTER 47—LATHING AND PLASTERING

**General**

**Sec. 4701.** Lathing and plastering shall be done in the manner and with the materials specified in this Chapter, and when required for fire protection shall also comply with the provisions of Chapter 43.

No plaster shall be applied until the lathing has been inspected and approved by the Building Official.

The Building Official may require that test holes be made in the wall for the purpose of determining the thickness and proportioning of the plaster, provided the permit holder has been notified 24 hours in advance of the time of making such test.

**Materials**

**Sec. 4702.** Materials shall conform to the following standards:

| MATERIALS  | U.B.C.<br>DESIGNATION |
|--|-----------------------|
| <b>Aggregate.</b>  |                       |
| Sand. Shall be washed and when used with portland cement for scratch-coat plastering the amount of sand retained on a No. 8 sieve shall be not less than 10 per cent or more than 30 per cent. | 47-1                  |
| Perlite. All perlite containers shall be marked indicating that the perlite contained therein conforms to U.B.C. Standard No. 47-1.  | 47-1                  |
| Vermiculite  | 47-1                  |
| <b>Gypsum Plaster.</b>   | 47-2                  |
| <b>Lime.</b>   |                       |
| Special Finishing Hydrated Lime (autoclaved)   | 24-17                 |
| Quicklime for structural purposes  | 24-14                 |
| (Lime putty shall be made from quicklime or hydrated lime and shall be prepared in an approved manner.)  |                       |
| <b>Keene's Cement.</b>   | 47-3                  |
| <b>Portland Cement.</b>  |                       |
| Type I, II, or III.  | 26-1                  |

| MATERIALS   | U.B.C.<br>DESIGNATION | Materials<br>(Cont'd.) |
|---|-----------------------|------------------------|
| <b>Portland Cement (Cont'd.)</b>  |                       |                        |
| Type I-A, II-A, or III-A Air-entraining Portland Cement.                  |                       |                        |
| Plastic or waterproof cement as specified in Section 2403 (o), Exception. | 24-19                 |                        |
| <b>Wood Lath.</b>   | 47-4                  |                        |
| <b>Fiber Insulation Lath.</b>   | 22-1                  |                        |
| <b>Gypsum Lath.</b>   | 47-5                  |                        |
| <b>Metal and Wire Lath, Metal Accessories and Channels.</b>               | 47-6                  |                        |

Sec. 4703. For gypsum, wood, and fiber insulation laths, the distance between supports shall conform to the requirements set forth in Table No. 47-A.

**Interior  
Plastering:  
Lathing**

The weight of metal and wire lath and the spacing of supports shall conform to the requirements set forth in Table No. 47-B. Attachment to supports shall be as set forth in Table No. 47-A.

Cornerite shall be provided at all interior angles except where metal or wire lath is carried around such intersections. Cornerite shall be nailed lightly or stapled to the lath (not to the framing members). Cornerite shall consist of flat or shaped reinforcing units of metal or wire lath which when shaped for angle reinforcing shall have minimum outstanding legs of two inches (2"), and shall weigh not less than 2.5 pounds per square yard.

No interior lath shall be applied until all exterior framing is covered.

Sec. 4704. Hollow partitions of lath and plaster shall have a shell thickness of not less than three-fourths inch ( $\frac{3}{4}$ ").

**Interior  
Plastering:  
Lath and  
Plaster  
Partitions**

The minimum thickness of solid partitions of lath and plaster shall be not less than two inches (2") nor one eighty-fourth of the distance between supports. Studless solid partitions of metal lath and plaster or gypsum lath and plaster shall be not more than twelve feet (12') in height.

Sec. 4705. The main runners and cross furring shall be not less than the sizes set forth in Table No. 47-C, except that other shapes of hot-rolled or cold-rolled members of equal strength may be substituted for those prescribed in the table.

**Interior  
Plastering:  
Suspended and  
Furred  
Ceilings**

Hangers for suspended ceilings shall be not less than the sizes set forth in Table No. 47-C, fastened to or embedded in the structural framing, masonry, or concrete.

**TABLE NO. 47-A—TYPE OF LATH—MAXIMUM SPACING OF SUPPORTS—METHOD OF ATTACHMENT**

| TYPE OF LATH                                       | WOOD SUPPORTS                |                    |  | MAXIMUM SPACING OF METAL SUPPORTS (Inches) |                    |
|--|------------------------------|--------------------|--|--|--------------------|
|  | SPACING OF SUPPORTS (Inches) |                    | SIZE AND TYPE OF NAIL                                | SPACING OF NAILS (Inches)                  |                    |
|  | Vert. Surfaces               | Horiz. Surfaces    |  |  |                    |
| $\frac{1}{8}$ " perf. gypsum lath <sup>1</sup>     | 16                           | 16                 | $1\frac{1}{8}$ " 13 ga. 19/64" dia. head blued nail  | 5  | 16 <sup>4</sup>    |
| $\frac{3}{8}$ " plain gypsum lath <sup>1</sup>     | 16                           | 16                 | $1\frac{1}{8}$ " 13 ga. 19/64" dia. head blued nail  | 5  | 16                 |
| $\frac{1}{2}$ " perf. gypsum lath <sup>1</sup>     | 16                           | 16                 | $1\frac{1}{4}$ " 13 ga. 19/64" dia. head blued nail  | 5  | 16                 |
| $\frac{1}{2}$ " plain gypsum lath <sup>1</sup>     | 24                           | 24                 | $1\frac{1}{4}$ " 13 ga. 19/64" dia. head blued nail  | 4  | 16                 |
| Wood lath  | 16                           | 16                 | 3d fine 16 ga. blued nails                           | —  | —                  |
| $\frac{1}{2}$ " fiber insulation lath <sup>2</sup> | 16                           | 16                 | $1\frac{1}{8}$ " fiberboard nails or 4d box nails    | $4\frac{1}{2}$                             | —                  |
| 1" fiber insulation lath <sup>2</sup>              | 16                           | 16                 | $1\frac{3}{4}$ " fiberboard nails or 6d box nails    | $4\frac{1}{2}$                             | —                  |
| Metal and wire lath <sup>3</sup>                   | See Table No. 47-B           | —                  | 4d common nails (bent over)                          | 6  | See Table No. 47-B |
| Metal and wire lath <sup>3</sup>                   | —                            | See Table No. 47-B | $1\frac{1}{2}$ " 11 ga. 7/16" dia. head barbed nails | 6  | See Table No. 47-B |

**NOTES:**

1. Gypsum lath shall be applied to wood supports with joints broken in each course except that end joints may fall on one support when stripped with three inches (3") of metal or wire lath. Joints between walls and ceilings shall be staggered. Lath shall be butted together. Lath shall be secured to horizontal or vertical metal supports by means of approved clips.

2. End joints of fiber insulation lath, except in interlocking-type lath, shall be not less than three-sixteenths inch ( $3/16$ ") wide. Shiplapped, tongued and grooved, or interlocking edges shall be fitted to moderate contact.

3. Metal and wire lath shall be lapped at least one mesh at sides and ends, but need not exceed one inch (1"). Lath shall be attached to horizontal and vertical metal supports so as not to exceed six-inch (6") spacing with not less than No. 18 U.S. steel wire gauge, galvanized annealed wire, or an equivalent approved attachment.

4. Sixteen-inch (16") spacing for clips giving continuous support to lath.

**TABLE NO. 47-B—WEIGHTS OF METAL  
AND WIRE LATH**

| WEIGHT<br>(Pounds per<br>Square Yard) | TYPE OF LATH                    | MAXIMUM<br>SPACING<br>OF SUPPORTS<br>(Inches) |                 |
|---------------------------------------|---------------------------------|---|-----------------|
|                                       |                                 | For<br>Walls                                  | For<br>Ceilings |
| 2.5                                   | Flat Expanded metal lath        | 16  | 0               |
| 3.4                                   | Flat Expanded metal lath        | 16  | 16              |
| 2.75                                  | Flat Rib metal lath             | 16  | 16              |
| 3.4                                   | Flat Rib metal lath             | 19  | 19              |
| 3.4                                   | $\frac{3}{8}$ " Rib metal lath* | 24  | 24              |
| 4.5                                   | Sheet metal lath                | 24  | 24              |
| 2.48                                  | Wire lath                       | 16  | 12              |
| **                                    | Wire fabric                     | 16  | 16              |

\*Rod-stiffened or V-stiffened flat expanded metal lath of equal rigidity and weight is permissible on the same spacings as  $\frac{3}{8}$ " rib metal lath.

\*\*Paper-backed wire fabric, No. 16 gauge wire, 2" x 2" mesh, with stiffener.

Hangers shall be saddle tied or wrapped around main runners so as to develop the full strength of the hangers. Lower ends of flat hangers shall be bolted with three-eighths-inch ( $\frac{3}{8}$ " ) bolts to runner channels, or bent tightly around runners and bolted to the main part of the hanger.

Cross furring shall be securely attached to main runners by (1) saddle tying with doubled No. 16 U.S. steel wire gauge galvanized wire, (2) with approved special clips, or (3) approved equivalent attachments.

**Sec. 4706. (a) Number of Coats.** Plastering with gypsum, lime, or portland cement plaster shall be three-coat work when applied over metal and wire lath, fiber insulation lath and wood lath, and shall be not less than two-coat work when applied over other plaster bases allowed in this Chapter.

**Interior  
Plastering:  
Number  
of Coats  
and Thickness**

Lime or portland cement plaster shall not be applied directly to fiber insulation lath or gypsum lath.

(b) **Thickness.** Grounds shall be installed to provide for the thickness of plaster, from face of plaster base to finished plaster surfaces, as set forth in Table No. 47-D.

If monolithic concrete ceiling surfaces require more than three-eighths inch ( $\frac{3}{8}$ " ) of plaster to produce desired lines or surfaces, metal lath or wire lath shall be attached thereto.

**Sec. 4707. (a) Base Coats. 1. Gypsum or hardwall plaster.** The proportion of sand, vermiculite, or perlite to 100 pounds of gypsum neat plaster shall not exceed the values set forth in Table No. 47-E.

**Interior  
Plastering:  
Proportioning  
and Mixing**

**2. Wood-fiber gypsum plaster.** On lath, mix with water only. On masonry, mix in proportions of 100 pounds of plaster to not more than 100 pounds of sand.

**3. Lime plaster.** The proportioning of lime, Keene's cement, and fiber to one cubic yard of sand shall be not less than the values set forth in Table No. 47-F.

TABLE NO. 47-C—SUSPENDED AND FURRED CEILINGS

| Minimum Sizes for Wire and Rigid Hangers  |  |   |  |   |
|---|--|---|--|---|
|   |  |   | MAXIMUM<br>AREA<br>SUPPORTED   | SIZE  |
| Hangers for Suspended Ceilings  |  |   | 12.5 sq. ft.<br>16 sq. ft.<br>18 sq. ft.<br>20 sq. ft.<br>22.5 sq. ft.<br>25.0 sq. ft. | 9 gauge wire<br>8 gauge wire<br>3/16" diameter, mild steel rod <sup>1</sup><br>7/32" diameter, mild steel rod <sup>1</sup><br>1/4" diameter, mild steel rod <sup>1</sup><br>1" x 3/16", mild steel flats <sup>2</sup> |
| Hangers for Attaching<br>Runners and Furring<br>Directly to Beams<br>and Joists | For Supporting<br>Runners  | Single Hangers<br>Between Beams <sup>3</sup>            | 8 sq. ft.<br>12 sq. ft.<br>16 sq. ft.  | 12 gauge wire<br>10 gauge wire<br>8 gauge wire  |
|   |  | Double Wire<br>Loops at Beams<br>or Joists <sup>3</sup> | 8 sq. ft.<br>12 sq. ft.<br>16 sq. ft.  | 14 gauge wire<br>12 gauge wire<br>11 gauge wire   |
|   | For Supporting<br>Furring Without<br>Runners <sup>4</sup><br>(Wire Loops at<br>Supports) | Type of Support:  |  |   |
|   |  | Concrete  | 8 sq. ft.  | 14 gauge wire   |
|   |  | Steel   | 8 sq. ft.  | 16 gauge wire (two loops) <sup>4</sup>  |
|   | Wood   | 8 sq. ft.   | 16 gauge wire (two loops) <sup>4</sup>   |   |

1. All rod hangers shall be protected with a zinc or cadmium coating or with a rust-inhibitive paint.

2. All flat hangers shall be protected with a zinc or cadmium coating or with a rust-inhibitive paint.

3. Inserts, special clips or other devices of equal strength may be substituted for those specified.

4. Two loops of No. 18 gauge wire may be substituted for each loop of No. 16 gauge wire for attaching steel furring to steel or wood joists.

5. These spans are based on webs of channels being erected vertically.

6. Other sections of hot- or cold-rolled members of equivalent beam strength may be substituted for those specified.

7. All gauges are U.S. steel wire gauges.

TABLE NO. 47-C (Continued)

| Minimum Sizes and Maximum Spans for Main Runners <sup>1, 2</sup>  |  |   |
|---|--|---|
| SIZE AND TYPE   | MAXIMUM SPACING OF<br>HANGERS OR SUPPORTS<br>(Along Runners) | MAXIMUM SPACING OF<br>RUNNERS<br>(Transverse)               |
| $\frac{3}{4}$ "—.3 lb. per ft., cold- or hot-rolled channel       | 2' 0"  | 3' 0"   |
| 1 $\frac{1}{2}$ "—.475 lb. per ft., cold-rolled channel           | 3' 0"  | 4' 0"   |
| 1 $\frac{1}{2}$ "—.475 lb. per ft., cold-rolled channel           | 3' 6"  | 3' 6"   |
| 1 $\frac{1}{2}$ "—.475 lb. per ft., cold-rolled channel           | 4' 0"  | 3' 0"   |
| 1 $\frac{1}{2}$ "—1.12 lb. per ft., hot-rolled channel            | 4' 0"  | 5' 0"   |
| 2"—1.26 lb. per ft., hot-rolled channel                           | 5' 0"  | 5' 0"   |
| 1 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ " x $\frac{3}{16}$ " angle    | 5' 0"  | 5' 0"   |
| Minimum Sizes and Maximum Spans for Cross Furring <sup>1, 2</sup> |  |   |
| SIZE AND TYPE   | MAXIMUM SPACING OF<br>RUNNERS OR SUPPORTS                    | MAXIMUM SPACING OF<br>CROSS FURRING MEMBERS<br>(Transverse) |
| $\frac{1}{4}$ " diameter pencil rods                              | 2' 0"  | 12"   |
| $\frac{3}{8}$ " diameter pencil rods                              | 2' 0"  | 19"   |
| $\frac{3}{8}$ " diameter pencil rods                              | 2' 6"  | 12"   |
| $\frac{3}{4}$ "—.3 lb. per ft., cold- or hot-rolled channel       | 3' 0"  | 24"   |
|   | 3' 6"  | 19"   |
|   | 4' 0"  | 16"   |
| 1"—.410 lb. per ft., hot-rolled channel                           | 4' 0"  | 24"   |
|   | 4' 6"  | 19"   |
|   | 5' 0"  | 12"   |

**TABLE NO. 47-D—REQUIRED THICKNESS OF INTERIOR PLASTER**

| BACKING                         | THICKNESS OF PLASTER INCLUDING FINISH COAT FROM FACE OF PLASTER BASE (Inches) |
|---------------------------------|---|
| Metal or Wire Lath              | $\frac{5}{8}$ minimum*  |
| All other types allowed         | $\frac{1}{2}$ minimum   |
| Unit Masonry and Concrete Walls | $\frac{5}{8}$ minimum   |
| Monolithic Concrete Ceilings    | $\frac{1}{8}$ minimum—<br>$\frac{3}{8}$ maximum                               |

\*Plaster thickness when measured from the back plane of metal lath, exclusive of ribs, shall be  $\frac{3}{4}$ " minimum.

**TABLE NO. 47-E—GYPSUM OR HARDWALL PLASTER**

| NUMBER OF COATS                  | COATS  | DAMP, LOOSE SAND (Pounds) | VERMICULITE OR PERLITE (Cubic Feet) |
|----------------------------------|--|---------------------------|-------------------------------------|
| Two-Coat Work (Double-up Method) | Base coat on gypsum lath                               | 250                       | 2½                                  |
|                                  | Base coat on masonry (except over monolithic concrete) | 300                       | 3                                   |
| Three-Coat Work                  | First (scratch) coat on lath                           | 200*                      | 2*                                  |
|                                  | First (scratch) coat on masonry                        | 300                       | 3                                   |
|                                  | All second (brown) coats                               | 300*                      | 3*                                  |

\*In lieu of the proportioning specified above, the proportions may be 100 pounds of gypsum neat plaster to not more than 250 pounds of damp, loose sand, or 2½ cubic feet of vermiculite or perlite, provided this proportioning is used for both scratch and brown coats.

**4. Portland cement plaster.** The first two coats shall be as required for the first two coats of exterior work.

**(b) Finish Coats for Gypsum, Lime, and Interior Portland Cement Plaster.** The finish coats shall be mixed, proportioned, and applied in an approved manner.

#### Interior Plastering: Application of Plaster

**Sec. 4708. (a) Base Coats. 1. Gypsum plaster.** The scratch coat shall be applied with sufficient material and pressure to form a full key or bond.

For two-coat work it shall be doubled back to bring the plaster out to grounds and straightened to a true surface and left rough to receive the finish coat. For three-coat work, the surface shall be scratched to provide a bond for the brown coat and shall have been in place at least 12 hours before the second or brown coat is applied. The second



TABLE NO. 47-F—LIME PLASTER

| NUMBER OF COATS                                    | COATS                      | LIME<br>(Cubic Feet<br>or Pounds)                                   | KEENE'S<br>CEMENT<br>(Pounds) | FIBER<br>(Pounds) |
|--|----------------------------|---|-------------------------------|-------------------|
| Two-Coat<br>Work<br>on Masonry<br>or Concrete      | Base coat                  | 7 cubic feet<br>lime putty<br>or<br>300 pounds<br>hydrated<br>lime  | 150                           | 4                 |
|  | First<br>(scratch)<br>coat | 10 cubic feet<br>lime putty<br>or<br>450 pounds<br>hydrated<br>lime | 200                           | 6                 |
| Three-Coat<br>Work<br>on Metal<br>and<br>Wire Lath | Second<br>(brown)<br>coat  | 7 cubic feet<br>lime putty<br>or<br>300 pounds<br>hydrated<br>lime  | 150                           | 4                 |

or brown coat shall be brought out to grounds, and straightened to a true surface and left rough, ready to receive the finish coat.

**Interior  
Plastering:  
Application  
of Plaster  
(Cont'd.)**

2. Lime plaster. The first two coats shall be applied in the same manner as gypsum plaster, except that in three-coat work, the second coat (brown) shall be applied over a dry base coat.

3. Portland cement plaster. The first two coats shall be as required for the first two coats of exterior work, except that the interval between the first and second coats shall be not less than 24 hours.

(b) Finish Coats. 1. Smooth white finish shall be applied over base coat which has set and is surface-dry. Thickness shall be from one-sixteenth inch ( $1/16''$ ) to one-eighth inch ( $1/8''$ ).

2. Sand-float finish shall be applied over set base coat which is not quite dry.

3. Keene's cement finish shall be applied over set base coat which is not quite dry. Thickness shall be from one-sixteenth inch ( $1/16''$ ) to one-eighth inch ( $1/8''$ ).

4. The finish coat for interior portland cement plastering shall be applied in the same manner as required for the third coat of exterior portland cement plaster.

5. Vermiculite finish coat shall be applied over a base coat which is semi-green. Thickness shall be from one-sixteenth inch ( $1/16''$ ) to one-eighth inch ( $1/8''$ ).

(c) Plaster on Monolithic Concrete. Monolithic concrete surfaces shall be clean, free from efflorescence, damp, and sufficiently rough to insure adequate bond.

Gypsum plaster applied to monolithic concrete ceilings shall be specially prepared bond plaster for use on concrete, to which water only shall be added. Gypsum plaster on monolithic walls and columns shall be applied over a scratch coat of bond plaster before it has set. The brown coat shall be brought out to grounds, straightened to a true surface and left rough, ready to receive finish coat.

Lime plaster applied to concrete walls shall be as specified in Section 4707.

Portland cement plaster applied to interior concrete walls or ceilings shall conform to requirements for application to exterior concrete walls as specified in Section 4711 (c).

**Interior  
Plastering:  
Staff**

**Sec. 4709.** Staff shall be soaked before sticking. Lugs shall be of pure fiber and plaster of Paris. Rust-resistive fastenings of sufficient strength to anchor the staff to the support shall be not less than No. 14 B. & S. gauge copper wire.

**Exterior  
Plastering:  
Backing**

**Sec. 4710. (a) Backing.** Studs shall be sheathed, or wire of not less than No. 18 U.S. steel wire gauge shall be stretched taut horizontally at intervals not exceeding six inches (6") on center vertically and securely fastened in place. This shall not be required with metal lath or paper-backed wire fabric.

**(b) Weather Protection.** Weather protection shall be as specified in Section 1707 (a).

**(c) Metal Reinforcement.** Exterior plaster, except when applied to concrete or masonry, shall be reinforced with one of the materials having a rust-resistive coating as set forth in Table No. 47-G.

Metal reinforcement shall be furred out from the backing at least one-fourth inch ( $\frac{1}{4}$ ") by an approved furring method, and shall be nailed with galvanized nails or approved furring devices driven to at least three-fourths-inch ( $\frac{3}{4}$ ") penetration which shall be spaced not more than six inches (6") apart vertically and sixteen inches (16") apart horizontally. Metal reinforcement shall be lapped at least one full mesh at all joints. When no sheathing is used, all vertical joints shall be made at the studs, and horizontal joints where expanded metal or metal lath is used shall have at least one tie between studs, made with No. 18 U.S. steel wire gauge galvanized annealed tie wire.

**Exterior  
Plastering:  
Application**

**Sec. 4711. (a) General.** Exterior cement plaster shall be portland cement plaster meeting the requirements of Table No. 47-H, except when applied over concrete or masonry.

**(b) Plasticity Agents.** Plasticity agents shall be of approved types and when added in the mixing of plaster shall be used in an amount not exceeding 10 per cent of the volume of portland cement. When added in the manufacturing process conforming to the requirements of Section 4702, no later additions shall be made.

TABLE NO. 47-G—EXTERIOR PLASTER  
REINFORCEMENT

| TYPE OF<br>REINFORCEMENT        | MINIMUM<br>GAUGE | MINIMUM WEIGHT<br>(Pounds per Square Yard) |
|---------------------------------|------------------|--|
| Expanded Metal                  |                  | 1.8  |
| Metal Lath                      |                  | 3.4  |
| Welded or Woven<br>Wire Netting | 18               | 1.4  |
| Welded Wire Fabric              | 16               | 1.0  |

TABLE NO. 47-H—EXTERIOR PORTLAND CEMENT  
PLASTER

| COAT                | MAXIMUM<br>VOLUME OF<br>SAND PER<br>VOLUME OF<br>CEMENT | MINIMUM<br>THICKNESS         | MINIMUM<br>PERIOD<br>MOIST<br>CURING | MINIMUM<br>INTERVAL BEFORE<br>APPLICATION OF<br>SUCCEEDING<br>COAT |
|---------------------|---|------------------------------|--------------------------------------|--|
| First or<br>scratch | 4   | 1/2" *                       | 48 hours                             | 48 hrs.***   |
| Second or<br>brown  | 5   | (1st & 2nd<br>coats)<br>3/4" | 48 hours                             | 7 days   |
| Third or<br>finish  | 3 **  | 1/8"                         |                                      |  |

\*Measured from backing to crest of scored plaster.

\*\*Approved prepared finish coats containing not less than 1/3 by weight of portland cement may be used.

\*\*\*To insure suction there should be a drying period after the moist curing period.

(c) **Application.** 1. **General.** Except when applied to concrete or masonry, and except as otherwise provided for pneumatically applied plaster, exterior cement plastering materials shall be mixed by machine methods for not less than two minutes, and shall be applied in three coats as set forth in Table No. 47-H.

The first coat shall be forced through all openings in the reinforcement so as to solidly fill all spaces. It shall then be scored horizontally with a scratcher having one-eighth-inch ( $\frac{1}{8}$ " ) clipped teeth and grooves not more than one-half inch ( $\frac{1}{2}$ " ) deep.

The second coat shall be rodded and water floated, with no variation greater than one-fourth inch ( $\frac{1}{4}$ " ) in any direction under a five-foot (5') straightedge.

The third coat may be a brush coat.

2. **Plastering on masonry or concrete.** The masonry surface on which plaster is to be applied shall be clean, free of efflorescence, damp, and sufficiently rough to insure proper bond. Mixtures specified for the second coat in this Section may be applied directly to masonry.

**Exterior  
Plastering:  
Application  
(Cont'd.)**

**Pneumatically  
Placed  
Plaster**

**Sec. 4712.** Pneumatically placed cement plaster shall be a mixture of portland cement and sand, mixed dry, conveyed by air through a pipe or flexible tube, hydrated at the nozzle at the end of the conveyor, and deposited by air pressure in its final position.

Rebound material may be screened and reused as sand in an amount not greater than 25 per cent of the total sand in any batch.

Pneumatically placed cement plaster shall consist of a mixture of one part cement to not more than five parts sand. Plasticity agents may be used as specified in Section 4711 (b). Except when applied to concrete or masonry, such plaster shall be applied in not less than two coats to a minimum total thickness of seven-eighths inch ( $\frac{7}{8}$ "). The first coat shall be rodded as specified in Section 4711 (c) for the second coat. The curing period and time interval shall be as set forth in Table No. 47-H.

**Portland  
Cement  
Plaster**

**Sec. 4713.** Portland cement plaster not less than one and one-half inch ( $1\frac{1}{2}$ ") in thickness reinforced in two directions with not less than 0.3 per cent of steel may be considered to act with the studs to resist bending and shear under horizontal forces when said reinforcement is anchored to the stud in such a manner as to resist effectively the stresses developed. The unit stresses for such reinforced plaster shall be not more than 50 per cent of those allowed for concrete set forth in Table No. 26-B, based on a compressive strength of such plaster of 1500 pounds per square inch.

## PART XI

### SPECIAL SUBJECTS

#### CHAPTER 48—FILM STORAGE

**Secs. 4801, 4802, and 4803.** Where it is desired to regulate film storage, complete provisions covering handling and storage of photographic and X-ray nitrocellulose films may be found in Appendix Chapter 48.

**Film  
Storage**

#### CHAPTER 49—MECHANICAL REFRIGERATION

**Secs. 4901 and 4902.** Where it is desired to regulate the type and installation of mechanical refrigeration, complete provisions may be found in Appendix Chapter 49.

**Refrigeration**

#### CHAPTER 50—PREFABRICATED CONSTRUCTION

**Sec. 5001. (a) Purpose.** The purpose of this Chapter is to regulate materials and establish methods of safe construction where any structure or portion thereof is wholly or partially prefabricated.

**General**

**(b) Scope.** Unless otherwise specifically stated in this Chapter, all prefabricated construction and all materials used therein shall conform to all the requirements of this Code. (See Section 105.)

**(c) Definition.** "Prefabricated assembly" is a structural unit, the integral parts of which have been built up or assembled prior to incorporation in the building.

**Sec. 5002.** Every approval of a material not specifically mentioned in this Code shall incorporate as a proviso the kind and number of tests to be made during prefabrication.

**Tests of  
Materials**

**Sec. 5003.** The Building Official may require special tests to be made on assemblies to determine their durability and weather resistance.

**Tests of  
Assemblies**

**Sec. 5004. (a) Design.** Every device designed to connect prefabricated assemblies shall be capable of developing the strength of the members connected, except in the case of members forming part of a structural frame designed as specified in Chapter 23. The connection device shall be designed as required by the other Chapters in this Code. Connections between roofs and the supporting walls shall be capable of withstanding an uplift equal to five pounds per square foot of roof.

**Connections**

**Sec. 5005. (a) Structural Design.** In structural design, due allowance shall be made for any material to be removed for the installation of pipes, conduits, or other equipment.

**Pipes and  
Conduits**

**Certificate  
and  
Inspection**

**Sec. 5006. (a) Materials.** Materials and the assembly thereof shall be inspected to determine compliance with this Code. Every material shall be grade marked or labeled where required elsewhere in this Code.

**(b) Certificate.** A certificate of approval shall be furnished with every prefabricated assembly, except where the assembly is readily accessible to inspection at the site. The certificate of approval shall certify that the assembly in question has been inspected and meets all the requirements of this Code. When mechanical equipment is installed so that it cannot be inspected at the site, the certificate of approval shall certify that such equipment complies with the laws applying thereto.

**(c) Certifying Agency.** To be acceptable under this Code, every certificate of approval shall be made by an approved agency.

**(d) Field Erection.** Placement of prefabricated assemblies at the building site shall be inspected by the Building Official to determine compliance with this Code.

**(e) Continuous Inspection.** If continuous inspection is required for certain materials where construction takes place on the site, it shall also be required where the same materials are used in prefabricated construction.

**EXCEPTION:** Continuous inspection will not be required during prefabrication if the approved agency certifies to the construction and furnishes evidence of compliance.

**CHAPTER 51—HEAT-PRODUCING  
APPLIANCES**

(See Appendix, Page 319)

## PART XII

### LEGISLATIVE

#### CHAPTER 60—LEGISLATIVE

**Sec. 6001.** If any section, subsection, sentence, clause, or phrase of this Ordinance is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this Ordinance. The City Council hereby declares that it would have passed this Ordinance, and each section, subsection, clause, or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses, and phrases be declared unconstitutional.

**Validity**

**Sec. 6002.** The U.B.C. Standards which are referred to in various parts of this Ordinance shall be the Uniform Building Code Standards, 1955 Edition, and are hereby declared to be a part of this Ordinance.

**Uniform  
Building  
Code  
Standards**

| U. B. C.<br>STD.<br>NO. | TITLE  | EXCERPTS FROM:  |
|-------------------------|--|---|
| <b>CHAPTER 4</b>        |  |   |
| 4-1                     | Incombustible Material<br>—Tests                             | P.C.B.O.C. Specifications   |
| <b>CHAPTER 9</b>        |  |   |
| 9-1                     | Flammable Liquids  | National Board of Fire Underwriters Pamphlet 30 (July, 1954)                                    |
| <b>CHAPTER 10</b>       |  |   |
| 10-1                    | Class III Dry-Cleaning Systems                               | Standards for Dry Cleaning Plants (Pamphlet 32—1954) of the National Board of Fire Underwriters |
| 10-2                    | Blower and Exhaust Systems for Dust, Stock and Vapor Removal | National Board of Fire Underwriters Pamphlet 91 (November, 1949)                                |
| <b>CHAPTER 22</b>       |  |   |
| 22-1                    | Fiberboard; Insulating                                       | Federal Specifications LLL-F-321b-42  |
| 22-2                    | Gypsum Sheathing Board                                       | Standard Specifications C79-54 of the American Society for Testing Materials                    |
| <b>CHAPTER 24</b>       |  |   |
| 24-1                    | Building Brick (Made from Clay or Shale)                     | Standard Specifications C62-50 of the American Society for Testing Materials                    |
| 24-2                    | Sand-Lime Building Brick                                     | Standard Specifications C73-51 of the American Society for Testing Materials                    |

**Uniform  
Building  
Code  
Standards  
(Cont'd.)**

| U. B. C.<br>STD.<br>NO. | TITLE   | EXCERPTS FROM:   |
|-------------------------|---|--|
| 24-3                    | Concrete Building<br>Brick                            | Standard Specifications C55-52<br>of the American Society for<br>Testing Materials     |
| 24-4                    | Sampling and Testing<br>Brick                         | Standard Methods C67-50 of<br>the American Society for<br>Testing Materials            |
| 24-5                    | Hollow Load-Bearing<br>Concrete Masonry<br>Units      | Standard Specifications C90-52<br>of the American Society for<br>Testing Materials     |
| 24-6                    | Solid Load-Bearing<br>Concrete Masonry<br>Units       | Standard Specifications C145-<br>52 of the American Society<br>for Testing Materials   |
| 24-7                    | Hollow Non-Load-<br>Bearing Concrete<br>Masonry Units | Standard Specifications C129-<br>52 of the American Society<br>for Testing Materials   |
| 24-8                    | Structural Clay Load-<br>Bearing Wall Tile            | Standard Specifications C34-52<br>of the American Society for<br>Testing Materials     |
| 24-9                    | Structural Clay Non-<br>Load-Bearing Tile             | Standard Specifications C56-52<br>of the American Society for<br>Testing Materials     |
| 24-10                   | Structural Clay Floor<br>Tile                         | Standard Specifications C57-52<br>of the American Society for<br>Testing Materials     |
| 24-11                   | Gypsum  | Standard Specifications C22-50<br>of the American Society for<br>Testing Materials     |
| 24-12                   | Gypsum Partition Tile<br>or Block                     | Standard Specifications C52-54<br>of the American Society for<br>Testing Materials     |
| 24-13                   | Reinforced Gypsum                                     | Building Requirements (ASA:<br>A59.1-1945) of the American<br>Standards Association    |
| 24-14                   | Quicklime for Struc-<br>tural Purposes                | Standard Specifications C5-26<br>of the American Society for<br>Testing Materials      |
| 24-15                   | Hydraulic Hydrated<br>Lime for Structural<br>Purposes | Standard Specifications C141-<br>42 of the American Society<br>for Testing Materials   |
| 24-16                   | Hydrated Lime for<br>Masonry Purposes                 | Standard Specifications C207-<br>49 of the American Society<br>for Testing Materials   |
| 24-17                   | Special Finishing<br>Hydrated Lime                    | Standard Specifications C206-<br>49 of the American Society<br>for Testing Materials   |
| 24-18                   | Cement, Masonry                                       | Standard Specifications C91-53<br>of the American Society for<br>Testing Materials     |
| 24-19                   | Air-Entraining<br>Portland Cement                     | Standard Specifications C175-<br>53 of the American Society<br>for Testing Materials   |
| 24-20                   | Aggregate for<br>Masonry Mortar                       | Tentative Specifications C144-<br>52T of the American Society<br>for Testing Materials |
| 24-21                   | Cast Stone  | Specification ACI 704-44 of the<br>American Concrete Institute                         |



| U. B. C.<br>STD.<br>NO. | TITLE | EXCERPTS FROM: |
|-------------------------|-------|----------------|
|-------------------------|-------|----------------|

Uniform  
Building  
Code  
Standards  
(Cont'd.)

## CHAPTER 25

|       |  |   |
|-------|--|---|
| 25-1  | American Lumber Standards for Softwood Lumber  | Simplified Practice Recommendation 16-53 of the U.S. Department of Commerce, Bureau of Standards  |
| 25-2  | Douglas Fir Plywood and Western Softwood Plywood                                     | Commercial Standards CS45-48 and CS132-49 of the U.S. Department of Commerce, Bureau of Standards   |
| 25-3  | Guide to the Grading of Structural Timbers and the Determination of Working Stresses | Miscellaneous Publication 185 (February, 1934) of the Forest Products Laboratory, U.S. Department of Agriculture                          |
| 25-3  | Recommendations for Basic Stresses   | Supplement No. 2 (June, 1948) to U.S. Department of Agriculture Miscellaneous Publication 185   |
| 25-4  | Douglas Fir, Coast Region  | Standard Grading and Dressing Rules for West Coast Lumber No. 14 (November 1, 1948) of the West Coast Lumbermen's Association             |
| 25-5  | Douglas Fir, Inland (Western Pine) Region  | Standard Grading Rules (for Douglas Fir) (January 1, 1953) of the Western Pine Association  |
| 25-6  | Tidewater Red Cypress  | Standard Specifications for Grades of Tidewater Red Cypress (June 15, 1953) of the Southern Cypress Manufacturers' Association            |
| 25-7  | Eastern Hemlock  | Official Grading Rules for Hemlock and Tamarack Lumber (November 15, 1950) of the Northern Hemlock and Hardwood Manufacturers Association |
| 25-8  | West Coast Hemlock   | Standard Grading and Dressing Rules for West Coast Lumber No. 14 (November 1, 1948) of the West Coast Lumbermen's Association             |
| 25-9  | Larch  | Standard Grading Rules (for Larch) (January 1, 1953) of the Western Pine Association  |
| 25-10 | Red and White Oak  | Standard Specifications for Structural Stress-Grades of Hardwoods and Cypress (1943) of the National Hardwood Lumber Association          |
| 25-11 | Southern Pine  | Standard Grading Rules for Southern Pine Lumber (September 1, 1948 and 1952 Supplement) of the Southern Pine Association                  |

Section 6002

Uniform  
Building  
Code  
Standards  
(Cont'd.)

UNIFORM BUILDING CODE

| U. E. C.<br>STD.<br>NO. | TITLE   | EXCERPTS FROM:  |
|-------------------------|---|---|
| 25-12                   | Southern Longleaf<br>Pine                             | Standard Grading Rules for<br>Southern Pine Lumber (Sep-<br>tember 1, 1948 and 1952 Sup-<br>plement) of the Southern<br>Pine Association  |
| 25-13                   | Redwood   | Standard Specifications for<br>Grades of California Red-<br>wood Lumber (January,<br>1954) of the California Red-<br>wood Association   |
| 25-14                   | Bolted Joints   | The material in this Standard<br>is identical with Part VI of<br>the National Design Specifi-<br>cation for Stress-Grade<br>Lumber and Its Fastenings<br>(1953), except that allow-<br>able loads are reduced by<br>one-sixth |
| 25-15                   | Timber Connector<br>Joints                            | The material in this Standard<br>is identical with Part V of<br>the National Design Specifi-<br>cation for Stress-Grade<br>Lumber and Its Fastenings<br>(1953), except that allow-<br>able loads are reduced by<br>one-sixth  |
| 25-16                   | Lag-Screw Joints                                      | The material in this Standard<br>is identical with Part VII of<br>the National Design Specifi-<br>cation for Stress-Grade<br>Lumber and Its Fastenings<br>(1953)  |
| 25-17                   | Drift Bolt Joints and<br>Wood Screw Joints            | National Design Specification<br>for Stress-Grade Lumber<br>and Its Fastenings (1953)<br>of the National Lumber<br>Manufacturers Association  |
| 25-18                   | Test for Glue Joints<br>in Laminated Wood<br>Products | Standard Method D1101-53 of<br>the American Society for<br>Testing Materials  |
| 25-19                   | Glued Laminated<br>Wood Structural<br>Members         | Technical Bulletin 1069 (Feb-<br>ruary, 1954) of the Forest<br>Products Laboratory, U.S.<br>Department of Agriculture   |
| 25-20                   | Structural Glued<br>Laminated Douglas<br>Fir Lumber   | Standard Specifications for<br>Design and Fabrication of<br>Structural Glued Laminated<br>Lumber (1953) of the West<br>Coast Lumbermen's Associa-<br>tion   |
| 25-21                   | Structural Glued<br>Laminated Southern<br>Pine        | Standard Specifications for<br>Design and Fabrication of<br>Structural Glued Laminated<br>Southern Pine (1954) of the<br>Southern Pine Association  |

Uniform  
Building  
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(Cont'd.)

| U. B. C.<br>STD.<br>NO. | TITLE   | EXCERPTS FROM:   |
|-------------------------|---|--|
| 25-22                   | Hardwood Glued Laminated Lumber                                   | Standard Specifications for Design and Fabrication of Hardwood Glued Laminated Lumber (1952)   |
| 25-23                   | Built-Up Members  | Wood Handbook (1940) of the Forest Products Laboratory, U.S. Department of Agriculture   |
| 25-24                   | Built-Up Columns  | Wood Handbook (1954) of the Forest Products Laboratory, U.S. Department of Agriculture   |
| 25-25                   | Spaced-Column Design  | National Design Specification for Stress-Grade Lumber and Its Fastenings (1953) of the National Lumber Manufacturers Association   |
| 25-26                   | The Designing for Strength of Flat Panels with Stressed Coverings | Pamphlet R1220 (July, 1946) of the Forest Products Laboratory, U.S. Department of Agriculture  |
| 25-27                   | Wood Poles  | Specifications and Dimensions (ASA: 05.1-1948) of the American Standards Association   |
| 25-28                   | Plank and Beam Construction                                       | Wood Utilization Data No. 3 (1940) of the National Lumber Manufacturers Association  |
| 25-29                   | Combined Flexural and Axial Loading                               | National Design Specification for Stress-Grade Lumber and Its Fastenings (1953) of the National Lumber Manufacturers Association   |
| 25-30                   | Adhesives, Casein and Resin Types                                 | Federal Specification C-G-456 (July 8, 1941) of the U. S. Federal Government<br>Joint Military Specification MIL-A-397B (February 3, 1953) of the U. S. Federal Government<br>Joint Military Specification MIL-A-5534A (June 15, 1951) of the U. S. Federal Government |

## CHAPTER 26

|      |                     |  |
|------|---------------------|--|
| 26-1 | Portland Cement     | Standard Specifications C150-53 of the American Society for Testing Materials  |
| 26-2 | Concrete Aggregates | Tentative Specifications C33-52T of the American Society for Testing Materials |

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(Cont'd.)**

| U. B. C.<br>STD.<br>NO. | TITLE   | EXCERPTS FROM:  |
|-------------------------|---|---|
| 26-3                    | Lightweight Aggregates for Structural Concrete                                      | Tentative Specifications C330-53T of the American Society for Testing Materials                           |
| 26-4                    | Billet-Steel Bars for Concrete Reinforcement  | Tentative Specifications A15-54T of the American Society for Testing Materials                            |
| 26-5                    | Rail-Steel Bars for Concrete Reinforcement  | Tentative Specifications A16-54T of the American Society for Testing Materials                            |
| 26-6                    | Cold-Drawn Steel Wire for Concrete Reinforcement                                    | Standard Specifications A82-34 of the American Society for Testing Materials                              |
| 26-7                    | Axle-Steel Bars for Concrete Reinforcement  | Tentative Specifications A160-54T of the American Society for Testing Materials                           |
| 26-8                    | Deformed Steel Bars for Concrete Reinforcement                                      | Tentative Specifications A305-53T of the American Society for Testing Materials                           |
| 26-9                    | Test for Compressive Strength of Molded Concrete Cylinders                          | Standard Method C39-49 of the American Society for Testing Materials                                      |
| 26-10                   | Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory | Standard Method C192-54 of the American Society for Testing Materials                                     |
| 26-11                   | Making and Curing Concrete Compression and Flexure Test Specimens in the Field      | Standard Method C31-49 of the American Society for Testing Materials                                      |
| 26-12                   | Ready-Mixed Concrete  | Tentative Specifications C94-54T of the American Society for Testing Materials                            |
| 26-13                   | Two-Way Slabs   | A.C.I. Building Code Requirements for Reinforced Concrete (ACI 318-51) of the American Concrete Institute |
| 26-14                   | Flat Slabs  | A.C.I. Building Code Requirements for Reinforced Concrete (ACI 318-51) of the American Concrete Institute |
| CHAPTER 27              |   |   |
| 27-1                    | Steel for Bridges and Buildings   | Tentative Specifications A7-53T of the American Society for Testing Materials                             |
| 27-2                    | Heavy and Light Gauge Structural Quality Flat Hot-Rolled Carbon-Steel Sheets        | Tentative Specifications A245-52T, A246-52T, and A303-52T of the American Society for Testing Materials   |
| 27-3                    | Design of Light Gauge Steel Structural Members                                      | Specification (January, 1949) of the American Iron and Steel Institute                                    |
| 27-4                    | Welded and Seamless Steel Pipe  | Tentative Specifications A53-54T of the American Society for Testing Materials                            |
| 27-5                    | Mild- to Medium-Strength Carbon-Steel Castings for General Applications             | Tentative Specifications A27-52T of the American Society for Testing Materials                            |

**Uniform  
Building  
Code  
Standards  
(Cont'd.)**

| U. B. C.<br>STD.<br>NO. | TITLE   | EXCERPTS FROM:   |
|-------------------------|---|--|
| 27-6                    | Gray Iron Castings  | Standard Specifications A48-48 of the American Society for Testing Materials                     |
| 27-7                    | Structural Rivet Steel  | Tentative Specifications A141-52T of the American Society for Testing Materials                  |
| 27-8                    | Assembly of Structural Joints Using High Strength Steel Bolts   | Specifications (February, 1954) of the American Institute of Steel Construction                  |
| 27-9                    | Arc and Gas Welding   | Standard Code for Arc and Gas Welding (1946) of the American Welding Society                     |
| 27-10                   | Mild Steel Arc-Welding Electrodes                               | Tentative Specifications A5.1-48T of the American Welding Society (A.S.T.M. A233-48T)            |
| CHAPTER 28              |   |  |
| 28-1                    | Round Timber Piles  | Tentative Specifications D25-54T of the American Society for Testing Materials                   |
| 28-2                    | Preservative Treatment of Piles by Pressure Processes           | Standard Specifications C1-54, C2-54, C3-54, C12-51 of the American Wood Preservers' Association |
| 28-3                    | Welded and Seamless Steel Pipe Piles                            | Standard Specifications A252-54 of the American Society for Testing Materials                    |
| CHAPTER 30              |   |  |
| 30-1                    | Dampers   | Pamphlet 90 (August, 1952) of the National Board of Fire Underwriters                            |
| CHAPTER 32              |   |  |
| 32-1                    | Wood Shingles   | Commercial Standard CS31-52 of the U.S. Department of Commerce, National Bureau of Standards     |
| CHAPTER 37              |   |  |
| 37-1                    | Fire-Clay Refractories  | Standard Specifications C27-41 of the American Society for Testing Materials                     |
| 37-2                    | Terms Relating to Refractories                                  | Standard Specifications C71-53 of the American Society for Testing Materials                     |
| CHAPTER 38              |   |  |
| 38-1                    | Installation of Sprinkler Systems                               | Pamphlet 13 (June, 1953) of the National Board of Fire Underwriters                              |
| 38-2                    | Carbon Dioxide Fire-Extinguishing Systems                       | Pamphlet 12 (March, 1951) of the National Board of Fire Underwriters                             |
| CHAPTER 42              |   |  |
| 42-1                    | Test Method for Fire Hazard Classification of Building Material | Standard Test Method, Subject 723 (August, 1950) Underwriters' Laboratories, Inc.                |

**Uniform  
Building  
Code  
Standards  
(Cont'd.)**

| U. B. C.<br>STD.<br>NO. | TITLE   | EXCERPTS FROM:  |
|-------------------------|---|---|
| 42-2                    | Prefabricated Acoustical Units<br>Standard Fire Tests               | Federal Specification SS-A-118a (February 12, 1948) U. S. Federal Government                    |
| CHAPTER 43              |   |   |
| 43-1                    | Fire Tests of Building Construction and Materials                   | Standard Methods E119-54 of the American Society for Testing Materials                          |
| 43-2                    | Fire Tests of Door Assemblies                                       | Standard Methods E152-41 of the American Society for Testing Materials                          |
| 43-3                    | Tin-Clad Fire Doors and Shutters                                    | Standard Subject 10(A), July, 1951, of Underwriters' Laboratories, Inc.                         |
| 43-4                    | Protection of Openings in Walls and Partitions Against Fire         | Pamphlet 80 (1941) of the National Board of Fire Underwriters                                   |
| CHAPTER 47              |   |   |
| 47-1                    | Inorganic Aggregates for Use in Interior Plaster                    | Tentative Specifications C35-53T of the American Society for Testing Materials                  |
| 47-2                    | Gypsum Plasters   | Standard Specifications C28-50 of the American Society for Testing Materials                    |
| 47-3                    | Keene's Cement  | Standard Specifications C61-50 of the American Society for Testing Materials                    |
| 47-4                    | Wood Lath   | Standard Specifications for Gypsum Plastering (A424-1950) of the American Standards Association |
| 47-5                    | Gypsum Lath   | Standard Specifications C37-54 of the American Society for Testing Materials                    |
| 47-6                    | Metal and Wire Lath   | Standard Specifications for Gypsum Plastering (A424-1950) of the American Standards Association |
| CHAPTER 48              |   |   |
| 48-1                    | Storage and Handling of Photographic and X-Ray Nitrocellulose Films | Pamphlet 41 (July 15, 1930) of the National Board of Fire Underwriters                          |
| 48-2                    | Nitrocellulose Motion Picture Film                                  | Pamphlet 40 (1953) of the National Board of Fire Underwriters                                   |
| CHAPTER 49              |   |   |
| 49-1                    | Mechanical Refrigeration  | Standard Safety Code (15-53) of the American Society of Refrigerating Engineers                 |
| CHAPTER 51              |   |   |
| 51-1                    | Storage and Handling of Liquefied Petroleum Gases                   | Pamphlet 58 (May, 1954) of the National Fire Protection Association                             |

**Sec. 6003.** Ordinance No. .... and all ordinances amendatory thereto, and all ordinances or parts of ordinances in conflict with this Ordinance are hereby repealed. **Ordinances Repealed**

**Sec. 6004.** This Ordinance shall be, and is hereby declared to be in full force and effect, from and after 30 days from its date of final passage and approval. **Date Effective**





# APPENDIX

The Appendix, pages 309 to 343, contains suggested ordinances covering subjects which may not be desired in all cities, also other pertinent information designed to be of assistance to the Building Official.

Additional material covering special requirements for Chapters 7, 13, 23, and 25 and referred to in these Chapters in the body of the Code is also included in the Appendix.

## CHAPTER 7

### REVIEWING STANDS

Refer to Sec. 702 (c). The following suggestions are given as a guide for the detailed design and construction of reviewing stands:

Every reviewing stand shall be constructed with four-inch by six-inch (4" x 6") girders running parallel to the front of such stand, spaced not more than six feet (6') apart, and supported at distances not exceeding six feet (6') apart by posts of not less than four inches by six inches (4" x 6"). These posts shall be braced diagonally with one-inch by six-inch (1" x 6") bracing, forming a continuous herringbone bracing, the full length of such stand for each vertical six feet (6') of such posts. The girders at the top of the posts shall be braced with braces not less than four inches by four inches (4" x 4") at right angles to the joists above the girders. Every post or brace shall be thoroughly secured to a foot plate, which shall be of sound wood not less than two inches by six inches (2" x 6") in cross section laid solidly on the ground at right angles to the front of the stand and forming the base for each line of posts. There shall be joists resting on the girders of not less than two inches by eight inches (2" x 8") cross section. Such joists shall be spaced not exceeding forty inches (40") apart and two-inch (2") plank shall be used for the seats and steps. Braces shall be provided whenever necessary to make a solid, substantial structure, which shall be safe under any possible emergency. All timbers forming the framing shall be thoroughly spiked together. There shall be a level stringer of two inches by six inches (2" x 6") cross section at the bottom of each line of posts, parallel to the stand; also a horizontal piece of two inches by six inches (2" x 6") cross section the full length of the stand and at right angles to same for every row of posts, and every six feet (6') of vertical height thereof. All timbers used in the construction of reviewing stands shall be sound (no second-hand or broken lumber permitted). Wherever the stand, or a portion thereof, extends over an excavation, the posts shall be extended to the bottom of said excavation and shall be braced with horizontal braces as hereinbefore provided.

## CHAPTER 13

## EXISTING BUILDINGS

**Existing  
Buildings**

**Sec. 1309. (a) Purpose.** The purpose of this Section is to provide a reasonable degree of safety to persons living and sleeping in apartment houses and hotels through providing for alterations to such existing buildings as do not conform with the minimum safety requirements of this Code.

**(b) Scope.** The provisions of this Section shall apply exclusively to existing nonconforming Group H occupancies more than two stories in height.

**(c) Effective Date.** Eighteen months after the effective date of this Section, every building falling within its scope shall be vacated until made to conform to the requirements of this Section.

**(d) Number of Exits.** Every apartment and every other sleeping room shall have access to not less than two exits. A fire escape as specified herein may be used as one required exit.

**(e) Stair Construction.** All stairs shall have a minimum run of nine inches (9") and a maximum rise of eight inches (8") and a minimum width exclusive of handrails of thirty inches (30"). Every stairway shall have at least one handrail. A landing having a minimum horizontal dimension of thirty inches (30") shall be provided at each point of access to the stairway.

**(f) Interior Stairways.** Every interior stairway shall be enclosed with walls of not less than one-hour fire-resistive construction.

Where existing partitions form part of a stairwell enclosure, wood lath and plaster in good condition will be acceptable in lieu of one-hour fire-resistive construction. Doors to such enclosures shall be protected by self-closing Class "B" fire doors or solid wood doors not less than one and three-eighths inch (1 $\frac{3}{8}$ ") thick. Enclosures shall include landings between flights and any corridors, passageways, or public rooms necessary for continuous exit to the exterior of the building.

The stairway need not be enclosed in a continuous shaft if cut off at each story by the fire-resistive construction required by this Subsection for stairwell enclosures.

Enclosures shall not be required if an automatic fire-extinguishing system is provided for all portions of the building except bedrooms, apartments, and rooms accessory thereto.

**(g) Exterior Stairways.** Exterior stairs shall be incombustible or of wood of not less than two-inch (2") nominal thickness with solid treads and risers.

**(h) Fire Escapes.** Fire escapes may be used as one means of egress, if the pitch does not exceed 60 degrees, the width is not less than eighteen inches (18"), the treads are not

less than four inches (4") wide, and they extend to the ground or are provided with counterbalanced stairs reaching to the ground. Access shall be by an opening having a minimum dimension of twenty-nine inches (29") when open. The sill shall be not more than thirty inches (30") above the floor and landing.

**Existing  
Buildings  
(Cont'd.)**

(i) **Doors and Openings.** Exit doors shall swing in the direction of exit travel, shall be self-closing, and shall be openable from the inside without the use of key or any special knowledge or effort. Doors shall not reduce the required width of stairway more than six inches (6") when open. Transoms, and openings other than doors, from corridors to rooms shall be fixed closed and shall be covered with a minimum of three-fourths-inch ( $\frac{3}{4}$ ") plywood.

(j) **Exit Signs.** Every exit doorway or change of direction of a corridor shall be marked with a well-lighted exit sign having letters at least five inches (5") high.

(k) **Enclosure of Vertical Openings.** Elevators, shafts, ducts, and other vertical openings shall be enclosed as required for stairways in Subsection (f) or by wired glass set in metal frames. Doors shall be incombustible, or as regulated in Subsection (f).

(l) **Separation of Occupancies.** Occupancy separations shall be provided as specified in Section 503. Lobbies, and public dining rooms not including cocktail lounges, shall not require a separation if the kitchen is so separated from the dining room. Boiler rooms or heater rooms containing a central heating plant using solid or liquid fuel shall be separated from the rest of the building by a "Special Occupancy Separation."

(m) **Alternates.** No alternate method of obtaining the fire protection and safety required by this Section may be used unless the Board of Appeals, including as a voting member for this purpose the Chief of the Fire Department, finds that such alternate method provides protection and safety equivalent to that required herein.

## CHAPTER 23

Refer to Sec. 2301.

### WEIGHTS OF BUILDING MATERIALS

|  | Lbs. Per<br>Cu. Ft. | Weights of<br>Building<br>Materials |
|--|---------------------|-------------------------------------|
| Brick, common .....                              | 125                 |                                     |
| Brick, common, laid $\frac{3}{8}$ " joints ..... | 120                 |                                     |
| Brick, pressed .....                             | 150                 |                                     |
| Brick, soft, laid $\frac{3}{8}$ " joints .....   | 100                 |                                     |
| Cast iron .....                                  | 450                 |                                     |
| Cinders, dry, bituminous, in bulk .....          | 45                  |                                     |
| Concrete—  |                     |                                     |
| Cinder, structural .....                         | 110                 |                                     |
| Stone or gravel .....                            | 144                 |                                     |
| Concrete building tile, 60% solid .....          | 87                  |                                     |
| Concrete building tile, 55% solid .....          | 79                  |                                     |

less than four inches (4") wide, and they extend to the ground or are provided with counterbalanced stairs reaching to the ground. Access shall be by an opening having a minimum dimension of twenty-nine inches (29") when open. The sill shall be not more than thirty inches (30") above the floor and landing.

**Existing  
Buildings  
(Cont'd.)**

(i) **Doors and Openings.** Exit doors shall swing in the direction of exit travel, shall be self-closing, and shall be openable from the inside without the use of key or any special knowledge or effort. Doors shall not reduce the required width of stairway more than six inches (6") when open. Transoms, and openings other than doors, from corridors to rooms shall be fixed closed and shall be covered with a minimum of three-fourths-inch ( $\frac{3}{4}$ ") plywood.

(j) **Exit Signs.** Every exit doorway or change of direction of a corridor shall be marked with a well-lighted exit sign having letters at least five inches (5") high.

(k) **Enclosure of Vertical Openings.** Elevators, shafts, ducts, and other vertical openings shall be enclosed as required for stairways in Subsection (f) or by wired glass set in metal frames. Doors shall be incombustible, or as regulated in Subsection (f).

(l) **Separation of Occupancies.** Occupancy separations shall be provided as specified in Section 503. Lobbies, and public dining rooms not including cocktail lounges, shall not require a separation if the kitchen is so separated from the dining room. Boiler rooms or heater rooms containing a central heating plant using solid or liquid fuel shall be separated from the rest of the building by a "Special Occupancy Separation."

(m) **Alternates.** No alternate method of obtaining the fire protection and safety required by this Section may be used unless the Board of Appeals, including as a voting member for this purpose the Chief of the Fire Department, finds that such alternate method provides protection and safety equivalent to that required herein.

## CHAPTER 23

Refer to Sec. 2301.

### WEIGHTS OF BUILDING MATERIALS

|  | Lbs. Per<br>Cu. Ft. | Weights of<br>Building<br>Materials |
|--|---------------------|-------------------------------------|
| Brick, common .....                              | 125                 |                                     |
| Brick, common, laid $\frac{3}{8}$ " joints ..... | 120                 |                                     |
| Brick, pressed .....                             | 150                 |                                     |
| Brick, soft, laid $\frac{3}{8}$ " joints .....   | 100                 |                                     |
| Cast iron .....                                  | 450                 |                                     |
| Cinders, dry, bituminous, in bulk .....          | 45                  |                                     |
| Concrete—  |                     |                                     |
| Cinder, structural .....                         | 110                 |                                     |
| Stone or gravel .....                            | 144                 |                                     |
| Concrete building tile, 60% solid .....          | 87                  |                                     |
| Concrete building tile, 55% solid .....          | 79                  |                                     |

**Weights of  
Building  
Materials  
(Cont'd.)**

|  | Lbs. Per<br>Cu. Ft. |
|--|---------------------|
| Earth—   |                     |
| Common loam, dry and loose .....                 | 76                  |
| Clay and gravel, dry and loose .....             | 100                 |
| Common earth, dry and packed .....               | 100                 |
| Wet mud .....                                    | 120                 |
| Glass .....                                      | 157                 |
| Granite .....                                    | 170                 |
| Granite masonry, dressed .....                   | 165                 |
| Granite masonry, rubble .....                    | 155                 |
| Gravel, dry .....                                | 120                 |
| Limestone masonry, dressed .....                 | 162                 |
| Marble masonry, dressed .....                    | 170                 |
| Mortar, hard, cement .....                       | 135                 |
| Mortar, hard, lime .....                         | 105                 |
| Sand, dry .....                                  | 100                 |
| Sand, wet .....                                  | 120                 |
| Slag (blast furnace) .....                       | 130                 |
| Steel .....                                      | 490                 |
| Terra cotta, filled with brickwork .....         | 120                 |
| Terra cotta, Dennison interlock tile, laid ..... | 65                  |
| Timber—  |                     |
| Fir, dry .....                                   | 32                  |
| Fir, wet .....                                   | 44                  |
| Oak .....  | 46                  |
| Water, fresh at 60 degrees Fahrenheit .....      | 62½                 |

|  | Lbs. Per<br>Sq. Ft. |
|--|---------------------|
| Ceilings—  |                     |
| Wood, lath and plaster .....                                       | 8                   |
| Metal lath and plaster suspended .....                             | 10                  |
| Partitions—  |                     |
| 2" x 4" studs, plaster board, ⅝" plaster, both sides .....         | 16                  |
| 2" x 4" studs, wood lath, ⅝" plaster, both sides .....             | 16                  |
| Channel studs, metal lath, cement plaster,<br>solid 2" thick ..... | 20                  |
| Plaster on hollow clay tile (one side) .....                       | 5                   |
| 2" hollow clay tile .....  | 13                  |
| 3" hollow clay tile .....  | 16                  |
| 4" hollow clay tile .....  | 18                  |
| 5" hollow clay tile .....  | 20                  |
| 6" hollow clay tile .....  | 25                  |
| 8" hollow clay tile .....  | 30                  |
| 12" hollow clay tile .....   | 45                  |
| Plaster on plaster-block partitions (one side) .....               | 5                   |
| 2" plaster blocks .....  | 7                   |
| 2½" plaster blocks .....   | 8.5                 |
| 3" plaster blocks .....  | 9.5                 |
| 3½" plaster blocks .....   | 10.5                |
| 4" plaster blocks .....  | 12                  |
| 5" plaster blocks .....  | 15                  |
| 6" plaster blocks .....  | 18                  |
| 8" plaster blocks .....  | 22                  |

|  | Lbs. Per<br>Sq. Ft. | Weights of<br>Building<br>Materials<br>(Cont'd.) |
|--|---------------------|--|
| Roofings—                                  |                     |  |
| Wood shingles .....                        | 3                   |  |
| Slate 3/16" .....                          | 7                   |  |
| Slate 1/4" .....                           | 10                  |  |
| Tile and clay shingles ..... 11 to         | 14                  |  |
| Roman tile, clay .....                     | 12                  |  |
| Spanish tile, clay .....                   | 19                  |  |
| Ludowici tile, Spanish .....               | 10                  |  |
| Tile roof laid in mortar, add .....        | 10                  |  |
| Copper (if no weight is specified) .....   | 1½                  |  |
| Tin .....                                  | 1                   |  |
| Corrugated iron .....                      | 2                   |  |
| Tar and gravel .....                       | 6                   |  |
| Prepared composition .....                 | 1                   |  |
| Skylights, metal-covered, wire glass ..... | 5                   |  |

### LATERAL BRACING

Refer to Sec. 2312. The following provisions are suggested for inclusion in the Code by cities located within an area subject to earthquake shocks:

**Lateral  
Bracing  
(Earthquake  
Regulations)**

**Sec. 2312. (a) General.** Every building or structure and every portion thereof, except Type V buildings of Group I occupancy which are less than twenty-five feet (25') in height, and minor accessory buildings, shall be designed and constructed to resist stresses produced by lateral forces as provided in this Section. Stresses shall be calculated as the effect of a force applied horizontally at each floor or roof level above the foundation. The force shall be assumed to come from any horizontal direction.

All bracing systems both horizontal and vertical shall transmit all forces to the resisting members and shall be of sufficient extent and detail to resist the horizontal forces provided for in this Section and shall be located symmetrically about the center of mass of the building or the building shall be designed for the resulting rotational forces about the vertical axis.

(b) **Horizontal Force Formula.** In determining the horizontal force to be resisted, the following formula shall be used:

$$F = CW$$

WHERE

"F" equals the horizontal force in pounds,

"W" equals the total dead load, tributary to the point under consideration.

**EXCEPTIONS:** 1. For warehouses, "W" shall equal the total dead load plus 50 per cent of the vertical design live load tributary to the point under consideration.

2. For tanks, "W" shall equal the total dead load plus the total live load.

TABLE NO. 23-C—HORIZONTAL FORCE FACTORS

**Lateral  
Bracing  
(Cont'd.)**

| PART OR PORTION  | VALUE<br>OF "C"*                                     | DIRECTION<br>OF FORCE            |
|--|--|----------------------------------|
| Floors, roofs, columns, and bracing in any story of a building or the structure as a whole**   | .15<br>$N† + 4\frac{1}{2}$                           | Any<br>direction<br>horizontally |
| Exterior bearing and non-bearing walls, interior bearing walls and partitions, interior non-bearing walls and partitions over ten feet (10') in height, masonry fences over six feet (6') in height. | .05<br>With a minimum of five pounds per square foot | Normal to<br>surface<br>of wall  |
| Cantilever parapet and other cantilever walls, except retaining walls  | .25  | Normal to<br>surface<br>of wall  |
| Exterior and interior ornamentations and appendages  | .25  | Any<br>direction<br>horizontally |
| When connected to or a part of a building: towers, tanks, towers and tanks plus contents, chimneys, smokestacks, and penthouses.   | .05  | Any<br>direction<br>horizontally |
| Tanks, elevated tanks, smokestacks, standpipes, and similar structures not supported by a building.  | .025   | Any<br>direction<br>horizontally |

\*See Map on inside back cover for zones. The values given "C" are minimum and should be adopted in locations not subject to frequent seismic disturbances as shown in Zone 1. For locations in Zone 2, "C" shall be doubled. For locations in Zone 3, "C" shall be multiplied by 4.

\*\*Where wind load as set forth in Section 2307 would produce higher stresses, this load shall be used in lieu of the factor shown.

†N is number of stories above the story under consideration, provided that for floors or horizontal bracing, N shall be only the number of stories contributing loads.

Machinery or other fixed concentrated loads shall be considered as part of the dead load.

"C" equals a numerical constant as shown in Table No. 23-C.

(c) **Foundation Ties.** In the design of buildings of Types I, II, and III, where the foundations rest on piles or on soil having a safe bearing value of less than 2000 pounds per square foot, the foundations shall be completely interconnected in two directions approximately at right angles to each other. Each such interconnecting member shall be

**Lateral  
Bracing  
(Cont'd.)**

capable of transmitting by both tension and compression at least 10 per cent of the total vertical load carried by the heavier only of the footings or foundations connected. The minimum gross size of each such member if of reinforced concrete shall be twelve inches by twelve inches (12" x 12") and shall be reinforced with not less than the minimum reinforcement specified in Section 2620. If the interconnecting members are of structural steel, they shall be designed as provided in Section 2702, and encased in concrete. A reinforced concrete slab may be used in lieu of interconnecting tie members, providing the slab thickness is not less than one forty-eighth of the clear distance between the connected foundations; also providing the thickness is not less than six inches (6").

Interconnecting slabs shall be reinforced with not less than eleven-hundredths square inch (.11 sq. in.) of steel per foot of slab in a longitudinal direction and the same amount of steel in a transverse direction. The bottom of such slab shall be not more than twelve inches (12") above the tops of at least 80 per cent of the piers or foundations. The footings and foundations shall be tied to the slab in such a manner as to be restrained in all horizontal directions.

(d) **Plans and Design Data.** With each set of plans filed, a brief statement of the following items shall be included:

1. A summation of the dead and live load of the building, floor by floor, which was used in figuring the shears for which the building is designed.
2. A brief description of the bracing system used, the manner in which the designer expects such system to act, and a clear statement of any assumptions used. Assumption as to location of all points of counterflexure in members must be stated.
3. Sample calculation of a typical bent or equivalent.

(e) **Detailed Requirements.** 1. **Bonding and tying.** Cornices and ornamental details shall be bonded in the structure so as to form an integral part of it. This applies to the interior as well as to the exterior of the building.

2. **Overturning moment.** In no case shall the calculated overturning moment of any building or structure due to the forces provided for in this Section exceed two-thirds of the moment of stability of such building or structure. Moment of stability shall be calculated using the same loads as used in calculating the overturning moment.

3. **Additions.** Every addition to an existing building or structure shall be designed and constructed to resist and withstand the forces provided for in this Section, and in any case where an existing building or structure is increased in height all portions thereof affected by such increased height shall be reconstructed to resist and withstand the forces provided for in this Section.

4. **Alterations.** No existing building or structure shall be altered or reconstructed in such a manner that the resistance



**Lateral  
Bracing  
(Cont'd.)**

to the forces provided for in this Section will be less than that before such alteration or reconstruction was made; provided, however, that this provision shall not apply to non-bearing partitions, and shall not apply to other minor alterations which are made in a manner satisfactory to the Building Department.

**5. Building separations.** All portions of buildings and structures shall be designed and constructed to act as an integral in resisting lateral forces unless structurally separated by a distance of at least one inch (1"), plus one-half inch ( $\frac{1}{2}$ ") for each ten feet (10') of height above twenty feet (20').

The details of sliding fragile joints shall be made satisfactory to the Building Official.

(f) **Lime Mortars.** Lime mortars shall not be used in any unit masonry construction forming a part of a building.

(g) **Intention or Interpretation of Lateral Force Provisions.** These lateral force requirements are intended to make buildings earthquake-resistive. The provisions of this Section apply to the buildings as a unit and also to all parts thereof, including the structural frame or walls, floor and roof systems, and other structural features.

The provisions incorporated in this Section are general and, in specific cases, may be interpreted or added to as to detail by rulings of the Building Official in order that the intent shall be fulfilled.

**CHAPTER 25****TERMITE PROVISIONS****Termite  
Provisions**

**Refer to Sec. 2516.** The following precautions are recommended for territories where foundation timber is subject to special hazard of decay and termite damage:

1. Before any new building is erected all stumps and roots shall be removed from the soil to a depth of at least twelve inches (12") below the surface of the ground in the area to be occupied by the building.

2. All wood members used to support permanently a load of any kind, in buildings over four hundred square feet (400 sq. ft.) in area, shall be of the grade and kind of lumber specified in Section 2805 when any part of such member is placed within eighteen inches (18") of any earth, either natural ground or earth fill.

3. Wood posts or columns shall not extend through or be placed directly on concrete floors. They shall be supported on concrete footings extending at least two inches (2") above the finished floor or may be placed on a corrosion-resisting metal plate at least one-sixteenth inch ( $\frac{1}{16}$ ") thick and not smaller than the base of the post or column. Such plate may be flush with the concrete floor.

4. Where timbers extend into a masonry wall at a point below the level of the ground outside of the wall, metal wall

**Lateral  
Bracing  
(Cont'd.)**

to the forces provided for in this Section will be less than that before such alteration or reconstruction was made; provided, however, that this provision shall not apply to non-bearing partitions, and shall not apply to other minor alterations which are made in a manner satisfactory to the Building Department.

5. **Building separations.** All portions of buildings and structures shall be designed and constructed to act as an integral in resisting lateral forces unless structurally separated by a distance of at least one inch (1"), plus one-half inch ( $\frac{1}{2}$ ") for each ten feet (10') of height above twenty feet (20').

The details of sliding fragile joints shall be made satisfactory to the Building Official.

(f) **Lime Mortars.** Lime mortars shall not be used in any unit masonry construction forming a part of a building.

(g) **Intention or Interpretation of Lateral Force Provisions.** These lateral force requirements are intended to make buildings earthquake-resistive. The provisions of this Section apply to the buildings as a unit and also to all parts thereof, including the structural frame or walls, floor and roof systems, and other structural features.

The provisions incorporated in this Section are general and, in specific cases, may be interpreted or added to as to detail by rulings of the Building Official in order that the intent shall be fulfilled.

**CHAPTER 25****TERMITE PROVISIONS****Termite  
Provisions**

**Refer to Sec. 2516.** The following precautions are recommended for territories where foundation timber is subject to special hazard of decay and termite damage:

1. Before any new building is erected all stumps and roots shall be removed from the soil to a depth of at least twelve inches (12") below the surface of the ground in the area to be occupied by the building.

2. All wood members used to support permanently a load of any kind, in buildings over four hundred square feet (400 sq. ft.) in area, shall be of the grade and kind of lumber specified in Section 2805 when any part of such member is placed within eighteen inches (18") of any earth, either natural ground or earth fill.

3. Wood posts or columns shall not extend through or be placed directly on concrete floors. They shall be supported on concrete footings extending at least two inches (2") above the finished floor or may be placed on a corrosion-resisting metal plate at least one-sixteenth inch ( $\frac{1}{16}$ ") thick and not smaller than the base of the post or column. Such plate may be flush with the concrete floor.

4. Where timbers extend into a masonry wall at a point below the level of the ground outside of the wall, metal wall

boxes shall be provided or the end and all surfaces of the timber within one foot (1') of the end shall be painted with at least two coats of hot coal-tar creosote or other approved wood preservative. **Termite Provisions (Cont'd.)**

5. All wood forms which have been used in placing concrete, if within the ground or less than eighteen inches (18") above the ground, shall be removed before a building is occupied or used for any purpose.

6. Loose or casual wood shall not be stored in direct contact with the ground under any building.

## CHAPTER 48

### PHOTOGRAPHIC AND X-RAY FILMS

**Refer to Chapter 48.** The following provisions are recommended for inclusion in the Code where provisions covering the handling and storage of photographic and X-ray nitrocellulose films are desired: **Photographic and X-ray Films**

**Sec. 4801.** The provisions of this Chapter do not apply to: **Classes of Film Excepted**

1. Film for amateur photographic use in original packages of "roll" and "film pack" films in quantities of less than fifty cubic feet (50 cu. ft.).

2. Safety film (cellulose acetate base).

3. Dental X-ray film.

4. Establishments manufacturing photographic films and storage incidental thereto.

5. Films stored or being used in standard motion picture booths (see Chapter 40).

Safety photographic and X-ray film (cellulose acetate base) may be identified by the marking on the edge of the film. This marking shows plainly before and after developing. Where film is not so marked it shall be inspected to determine whether it is of the safety acetate or nitrate type.

**Sec. 4802.** All regulations for the storage and handling of photographic and X-ray nitrocellulose films shall conform to the requirements set forth in U.B.C. Standard No. 48-1. **General Regulations**

**EXCEPTION:** Where definite fire-resistive materials are specified, materials of equal fire resistance as specified in this Code may be used.

**Sec. 4803.** The storage and handling of nitrocellulose motion picture film shall conform to the requirements set forth in U.B.C. Standard No. 48-2. **Motion Picture Film**

boxes shall be provided or the end and all surfaces of the timber within one foot (1') of the end shall be painted with at least two coats of hot coal-tar creosote or other approved wood preservative. **Termite Provisions (Cont'd.)**

5. All wood forms which have been used in placing concrete, if within the ground or less than eighteen inches (18") above the ground, shall be removed before a building is occupied or used for any purpose.

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**CHAPTER 49**

**REFRIGERATION SYSTEMS**

**Refrigeration Systems**      **Refer to Chapter 49.** Where it is desired to regulate the installation or alteration of refrigeration systems, the following provisions are recommended for inclusion in the Code:

**General**                      **Sec. 4901.** It shall be unlawful for any person, firm, or corporation to install or alter or cause to be installed or altered, any system of refrigeration, unless such system is an approved type and is installed in accordance with the provisions set forth in U.B.C. Standard No. 49-1.

**Scope**                        **Sec. 4902.** Regulations of this Chapter shall apply to all refrigeration systems hereafter installed and to alterations of and additions to such existing systems.

## CHAPTER 51—HEAT-PRODUCING APPLIANCES

Sec. 5101. (a) **General.** Heat-producing appliances other than electrical shall conform to the requirements of this Chapter.

**Construction,  
Installation  
and  
Performance  
Requirements**

(b) **Approvals.** Each heat-producing appliance and accessory shall be of a type complying with applicable nationally recognized standards as determined by an approved testing agency.

Where no such standards exist, approval of the Building Official shall be obtained before the appliance or accessory is installed.

(c) **Type of Fuel.** Each appliance shall be designed for use with the type of fuel to which it will be connected. No appliance shall be converted from the fuel specified on the rating plate for use with a different fuel without consulting the manufacturer for complete instructions and securing reapproval from the Building Official.

(d) **Installation.** The installation of heat-producing appliances covered by this Chapter shall conform to the conditions of approval as specified in the manufacturer's instructions pertaining to safety and to the requirements of this Chapter. The installer shall leave the manufacturer's instructions attached to the appliance for the benefit of the Building Official.

Appliances installed in garages or other areas where they may be subjected to mechanical damage shall be suitably guarded against such damage by being installed behind protective barriers or by being elevated or located out of the normal path of a vehicle using such garage.

(e) **Connections.** Requirements shall be as follows:

1. All heat-producing appliances burning gas and liquid fuel shall be rigidly connected to the fuel-piping outlet with solid iron pipe except as hereafter provided.

2. Before any contemplated use of existing lines, pipe sizes shall be verified through the proper administrative authorities. If such piping is found inadequate, separate fuel lines shall be installed from source to the heating appliance.

3. Semi-rigid seamless tubing may be used to connect any oil-burning appliance. The maximum length shall be three feet (3') and it shall be of an approved type. The capacity shall be that required by the appliance. Such tubing shall not pass through any wall, floor, or partition.

4. Gas-burning appliances burning not more than 100,000 B.t.u. per hour may be connected with approved semi-rigid or flexible seamless metal tubing.

The method of attaching such connectors to the gas piping and appliance shall not depend upon separate ferrules, washers, gaskets, or other detachable parts for gas-

**Construction,  
Installation  
and  
Performance  
Requirements  
(Cont'd.)**

tightness, nor shall such separate parts be used to establish and maintain the method of seal provided within the connector and fittings.

The capacity shall be that required by the appliance.

The over-all length of such connectors shall not exceed three feet (3').

**EXCEPTION:** Ranges may be connected with connectors not exceeding six feet (6') in length.

No part of such connectors shall be concealed within or run through any wall, floor, or partition.

5. A separate shut-off valve shall be installed in all fuel lines ahead of the union connection and within six feet (6') of the appliance which it serves. This shall be in addition to any valve which is a part of the appliance.

6. All electrical connections and wiring shall be made in accordance with the electrical code. This shall not apply to enclosed wiring which is an integral part of any approved electrically controlled device. Gas piping shall not be used for an electrical ground or in lieu of wiring.

(f) **Clearances.** Clearances of heat-producing appliances from combustible material shall be as specified in this Chapter or as set forth in Table No. 51-A.

**Fresh-Air Supply  
for  
Combustion**

**Sec. 5102. (a) Fresh-Air Supply.** All fuel-burning appliances shall be assured a sufficient supply of fresh air for proper fuel combustion.

(b) **Space.** Provisions shall be made to supply fresh air to the space in which fuel-burning appliances are located, if the volume, in cubic feet, of this space is less than:

1. One-twentieth of the maximum rated input in B.t.u.'s of all gas-burning appliances in such space.

2. One-tenth of the maximum rated input in B.t.u.'s of all appliances burning solid and liquid fuel in such space.

(c) **Methods of Supplying Fresh Air.** Where provisions for fresh air are required in this Section, the Building Official shall specify which of the following methods shall be used:

1. Permanent openings or ducts leading from the appliance enclosure to the outside of the building. For gas-burning appliances, such openings or ducts shall have a total unobstructed area of not less than one hundred square inches (100 sq. in.), plus an additional one square inch (1 sq. in.) for each 1000 B.t.u. in excess of 100,000. For input capacity in excess of 500,000 B.t.u. the area shall be five hundred square inches (500 sq. in.) plus an additional one square inch (1 sq. in.) for each 1500 B.t.u. in excess of 500,000. For input capacities in excess of 1,000,000 B.t.u. the area shall be eight hundred square inches (800 sq. in.) plus one additional square inch (1 sq. in.) for each 2000 B.t.u. in excess of 1,000,000. For appliances burning solid

**TABLE NO. 51-A—REDUCTION OF REQUIRED CLEARANCES OF APPLIANCES FROM COMBUSTIBLES**  
(In inches, with minimum specified forms of protection)

| WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION IS:  |           |                |            |           |                |                    |           |                |          |                |                    |          |                |           |       |
|--|-----------|----------------|------------|-----------|----------------|--------------------|-----------|----------------|----------|----------------|--------------------|----------|----------------|-----------|-------|
| TYPE OF PROTECTION   | 36 Inches |                |            | 18 Inches |                |                    | 12 inches |                | 9 Inches |                |                    | 6 Inches |                | 3 Inches  |       |
|  | Above     | Sides and Rear | Smoke Pipe | Above     | Sides and Rear | Smoke or Vent Pipe | Above     | Sides and Rear | Above    | Sides and Rear | Smoke or Vent Pipe | Above    | Sides and Rear | Vent Pipe | Above |
| (a) ¼ in. asbestos mill-board spaced out 1 in.**   | 30        | 18             | 30         | 15        | 9              | 12                 | 9         | 6              |          | 6              |                    | 3        | 2              | 3         | 2     |
| (b) 28 gauge sheet metal on ¼ in. asbestos millboard.....  | 24        | 18             | 24         | 12        | 9              | 12                 | 9         | 6              |          | 4              |                    | 3        | 2              | 2         | 1     |
| (c) 28 gauge sheet metal spaced out 1 in.**  | 18        | 12             | 18         | 9         | 6              | 9                  | 6         | 4              |          | 4              |                    | 2        | 2              | 2         | 2     |
| (d) 28 gauge sheet metal on ⅛ in. asbestos millboard spaced out 1 in.**                            | 18        | 12             | 18         | 9         | 6              | 9                  | 6         | 4              |          | 4              |                    | 2        | 2              |           | 2     |
| (e) 1½ in. asbestos cement covering on heating appliance.....                                      | 18        | 12             |            | 9         | 6              |                    |           | 4              |          |                |                    | 2        |                |           | 1     |
| (f) ¼ in. asbestos mill-board on 1 in. rock-wool bats reinforced with wire mesh or equivalent..... | 18        |                |            | 6         |                |                    |           | 4              |          | 4              |                    | 2        | 2              | 2         | 2     |
| (g) 22 gauge sheet metal on 1 in. rockwool bats reinforced with wire mesh or equivalent.....       | 18        |                |            | 4         |                | 3                  | 2         | 2              |          |                |                    | 2        | 2              |           | 2     |
| (h) ¼ in. asbestos cement board or ¼ in. asbestos millboard.....                                   | —         | —              | —          | —         | —              | —                  | —         | —              |          | —              |                    | —        | —              | 4         | 2     |
| (i) ¼ in. cellular asbestos..  | —         | —              | —          | —         | —              | —                  | —         | —              |          | —              |                    | —        | —              | 4         | 1     |

\*All clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material. A dash indicates no reduction in clearance permitted.

\*\*Spacers shall be of noncombustible material.



**TABLE NO. 51-B—MINIMUM CLEARANCES—HEATING FURNACES AND  
BOILERS FROM COMBUSTIBLES**

| HEATING FURNACES AND BOILERS  | MINIMUM CLEARANCE, INCHES |                   |       |
|---|---------------------------|-------------------|-------|
|   | ABOVE*                    | SIDES AND<br>REAR | FRONT |
| Blower-type warm-air furnaces, automatically fired<br>with 250° F. temperature-limit control**  |                           |                   |       |
| Burning liquid or solid fuel .....  | 6                         | 6                 | 48    |
| Burning gas .....   | 6                         | 6                 | 18    |
| Hot-water and steam boilers operating at not over<br>15 lbs. gauge pressure, of water-wall type or having<br>a jacket or lining of masonry or other satisfactory<br>insulating material |                           |                   |       |
| Burning liquid or solid fuel .....  | 6                         | 6                 | 48    |
| Burning gas .....   | 6                         | 6                 | 18    |
| Heating boilers and furnaces (including warm-air<br>furnaces) other than as above   |                           |                   |       |
| Burning liquid or solid fuel .....  | 18                        | 18                | 48    |
| Burning gas .....   | 18                        | 18                | 18    |

\*The clearances above warm-air furnaces shall be measured from the furnace bonnet or warm air plenum chamber.

\*\*"Blower-type warm-air furnaces with 250° F. temperature limit control" shall be defined as automatically fired warm-air furnaces equipped with a fan to circulate the air and with approved automatic temperature-limit controls that cannot be set higher than 250° F. and if coal-stoker fired, equipped also with an automatic overrun control to operate the fan when the air reaches a temperature not higher than 250° F. even though the controlling thermostat is not calling for heat.

or liquid fuels the required areas shall be one and one-half times those required for gas-burning appliances.

2. Permanent openings or ducts leading from the appliance location to other interior areas which meet the minimum required volume specified in Subsection (b). Such openings or ducts shall be not less in size than those specified in Subsection (c) 1.

Where openings of ducts are used, they shall consist of two or more, of approximately equal area, one or more within six inches (6") of the ceiling of the appliance enclosure and one or more within six inches (6") of the floor of the appliance enclosure.

**Sec. 5103. (a) General.** Every heat-producing appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction. Sufficient room shall be available to enable the operator to observe the burner, control, and pilot while starting the appliance. The operating instructions must be in a position where they can be easily read. **Access**

(b) **Furnace or Boiler Room.** Each furnace or boiler room shall have an opening or door and passageway large enough to permit removal of the largest piece of the furnace.

(c) **Horizontal Furnaces Installed under First Floor, and Attic Furnaces.** The space under the first floor in which any horizontal furnace is installed or the space in which any attic furnace is installed shall be accessible by an opening and passageway as large as the largest piece of the furnace, but not less than thirty inches by thirty inches (30" x 30") and shall be continuous from the opening to the furnace controls and valves. The opening to the passageway shall be located not more than twenty feet (20') from the furnace. An electric light shall be provided at or near the furnace location, controlled by a switch located at or ahead of the passage opening. Every passageway to an attic furnace shall have solid continuous flooring not less than twenty-four inches (24") wide from the entrance opening to the furnace. A ladder permanently fastened to the building or equal access shall be provided leading to the attic opening.

(d) **Floor Furnace.** The space in which any floor furnace is installed shall be accessible by an opening in the foundation not less than twenty-four by eighteen inches (24" x 18") or trap door not less than twenty-four by eighteen inches (24" x 18") in any cross section thereof, and a passageway not less than twenty-four by eighteen inches (24" x 18") in any cross section thereof. The passageway shall be continuous from the opening or trap door to the furnace controls and valves, and the opening to the passageway shall be located not more than twenty feet (20') from the furnace.

(e) **Water Heaters.** Access to water heaters installed in an attic must comply with the provisions of Subsection (c) to provide suitable access.

**Residential  
Space Heating  
Devices and  
Controls**

**Sec. 5104. (a) Automatic Devices for Use on Residential Space Heating Appliances.** Requirements shall be as follows:

1. All natural, manufactured, or mixed gas-burning appliances shall be equipped with approved devices which will shut off the gas to the main burner or burners in the event of pilot failure.

**EXCEPTION:** Manually controlled floor furnaces and manually controlled room heaters.

2. Liquefied petroleum or mixed liquefied petroleum gas-air-burning appliances shall be equipped with automatic devices which will shut off the flow of gas to the pilot and main burner or burners in the event of pilot failure.

3. Liquid-fuel-burning appliances shall be equipped with approved devices to shut off the fuel supply to the main burner or burners in the event of ignition failure.

(b) **Remote Controls.** All heating appliances whose manual controls are not readily accessible from the main portion of the dwelling being heated shall be equipped with remote controls.

**EXCEPTION:** Hand-fired equipment burning solid or liquid fuel.

(c) **Limit Controls.** Where a gravity warm-air heating system is installed with at least one warm-air outlet not less than thirty-five square inches (35 sq. in.) and permanently open and unobstructed, except for an open-faced grille, a temperature-limit control will not be required on the appliance. Any warm-air heating appliance which conveys heat through duct work shall be equipped with an approved temperature-limit control located in the bonnet or plenum. Such limit control shall have a fixed stop which will limit the outlet air temperature to 250 degrees Fahrenheit.

**Space Heating  
Furnaces and  
Boilers**

**Sec. 5105. (a) General.** The equipment covered by this Section shall be installed according to the provisions of this Chapter. Such equipment shall not be altered nor shall the fuel input be increased in excess of the manufacturer's rated input. Defective material or parts shall be replaced in such a manner as not to invalidate the approvals as specified in Section 5101 (b).

(b) **Labeling.** Equipment covered by this Section shall bear a permanent and legible name plate on which shall appear:

1. The manufacturer's name.
2. The manufacturer's rating of the appliance.
3. A model designation.
4. Instructions for the lighting, operation, and shutdown of the appliance.
5. The type of fuel approved for use in the appliance.
6. A seal of approval of the appliance by an approved

testing laboratory if acceptance is based on such approval. **Space Heating Furnaces and Boilers**  
(Cont'd.)

(c) **Air Supply for Combustion.** Air for combustion shall be supplied as specified in Section 5102.

(d) **Circulating Air Supply.** Circulating air used for conveying heat and for ventilation may be taken from outside the building, from rooms used for living quarters inside the building, or from both sources. Such circulating air shall be conducted to blower-type furnaces in continuous ducts of incombustible material.

Circulating air supply openings or ducts for gravity-type warm-air furnaces shall have a total net area of not less than two square inches (2 sq. in.) for each 1000 B.t.u. maximum input of all such furnaces being supplied. In no case shall the total net area of such openings or ducts be less than two hundred square inches (200 sq. in.).

Circulating air for blower-type warm-air furnaces shall be conducted into the blower housing from outside the furnace space by continuous airtight ducts.

No circulating air supply inlet for blower-type warm-air furnaces shall be located in the following positions:

1. Closer than ten feet (10') from any appliance firebox or draft diverter which is located in the same enclosed space as the air-supply inlet.

2. Closer than ten feet (10') from any appliance vent outlet.

3. Where it will pick up objectionable odors, fumes, or flammable vapors.

4. Where it is located in the same enclosed space as the combustion air inlet.

No damper shall be placed in any air intake, except that a diverting damper may be placed in a combination fresh-air intake and return-air intake so arranged that for all possible positions of the damper, the cross-sectional area of the circulating-air intake to the furnace is not less than the total cross-sectional area of all hot-air outlets.

(e) **Venting.** Heating furnaces or boilers covered by this Section shall be connected to a vent or chimney complying with Chapter 37 of this Code.

(f) **Location.** Space heating furnaces and boilers shall be located in accordance with the following requirements:

1. Heating furnaces shall not be installed in an attic unless of a type approved for such use.

2. Floor furnaces may be installed in an upper floor provided the furnace assembly projects below into a utility room closet, garage, or similar nonhabitable space. In such installations where fire separation is required the furnace shall be entirely separated from the nonhabitable space by means of the required fire-resistive construction. Adequate means for air intake and service access shall be provided. Minimum furnace clearance of six inches (6") on all sides shall be maintained between the furnace and enclosure.

**Space Heating  
Furnaces and  
Boilers  
(Cont'd.)**

3. No forced-air or gravity central heating furnaces shall be located in any room used or designed to be used for sleeping purposes, bathroom, clothes closet, or in any confined space with access only to the above locations. No warm-air furnace shall be located in or serve any surgical operating room or other hazardous location.

(g) **Mounting. 1. Heating furnaces.** Heating furnaces and boilers, except floor furnaces, shall be mounted as follows:

A central heating furnace or boiler shall be erected in accordance with the manufacturer's instructions and shall be installed on a firm, level floor of Type I construction unless listed for installation on a combustible floor or the floor is protected in an approved manner. Such construction shall in all cases extend not less than twelve inches (12") beyond the appliance on all sides, and where solid fuel is used shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

Blower-type warm-air furnaces may be mounted on floors other than as specified in this Subsection, provided they are so arranged that the fan chamber occupies the entire area beneath the firing chamber and forms a ventilated air space between the firing chamber and the floor of not less than eighteen inches (18") in height with at least one metal baffle between the firing chamber and the floor.

Heating boilers of the water-base type may be mounted on floors other than as specified in this Subsection, provided the water chamber extends under the whole of the ash pit and firebox, or under the whole of the firing chamber if there is no ash pit.

Appliances which are set on legs which provide not less than four inches (4") open space under the base of the appliance may be mounted on floors other than as specified in this Subsection, provided the appliance is such that flame or hot gases do not come in contact with its base, and further provided that the floor under the appliance is protected with not less than one-fourth inch ( $\frac{1}{4}$ ") of asbestos millboard covered with sheet metal of not less than 24 U. S. gauge. This specified floor protection shall extend not less than six inches (6") beyond the appliance on all sides.

Appliances which are arranged so that the flame or hot gases do not come in contact with the base may be mounted on floors other than as specified in this Subsection, provided the floor under the appliance is protected with hollow masonry not less than four inches (4") in thickness, covered with sheet metal of not less than 24 U. S. gauge. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air from side to side through the masonry.

Appliances which are arranged so that flame or hot gases come in contact with the base may be mounted on floors other than as specified in this Subsection, provided the floor under the appliance is protected by two courses of four-inch (4") hollow clay tile of eight inches (8") minimum

thickness or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide a free circulation of air through such masonry courses, and covered with steel plate not less than three-sixteenths inch (3/16") in thickness.

**Space Heating  
Furnaces and  
Boilers  
(Cont'd.)**

**2. Floor furnaces.** The floor around the furnace shall be braced and headed with a framework of material not lighter than the joists or girders.

Floor furnaces shall be supported independently of the grilles.

The lowest portion of the floor furnace shall have at least a six-inch (6") clearance from the ground, except that where the lower six-inch (6") portion of the floor furnace is sealed by the manufacturer to prevent entrance of water, the clearance may be reduced to not less than two inches (2"). When that clearance is not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that there is a six-inch (6") clearance beneath the lowest portion of the furnace and a twelve-inch (12") clearance on all sides, except the control side which shall have an eighteen-inch (18") clearance. Whenever the excavation exceeds twelve inches (12") in depth, or water seepage is likely, a watertight copper pan, concrete pit, or other suitable material shall be used. A copper pan shall be made of not less than sixteen-ounce-per-square-foot sheet copper. The pan shall be anchored in place, so as to prevent floating, and the walls shall extend at least four inches (4") above the adjacent ground level, with twelve-inch (12") clearances on all sides except the control side, which shall have eighteen-inch (18") clearance. When the equipment is sealed by the manufacturer to meet this condition, the pan or pit may be omitted if not required for maintaining a dry condition for service access.

Floor furnaces shall not be installed where concrete slab floors are used.

**(h) Clearances. 1. Heating furnaces.** Clearances of heating furnaces and boilers except floor furnaces from combustible material shall be as follows:

Except as herein provided, heating furnaces and boilers shall be installed to provide clearances to woodwork or other combustible material whether plastered or unplastered, not less than as set forth in Table No. 51-B. Floor-mounted direct-fired unit heaters shall be installed with clearances as set forth in Table No. 51-B for appliances of similar heat-producing characteristics.

Heating furnaces and boilers which are approved for installation with lesser clearances than specified in this Subsection, may be installed in accordance with the conditions of such approval.

**2. Floor furnaces.** With the exception of wall-register models, a floor furnace shall not be placed closer than six inches (6") to the nearest wall, and wall-register models shall not be placed closer than six inches (6") from a corner.

**TABLE NO. 51-C—MINIMUM CLEARANCES FOR  
APPROVED GAS-FIRED ROOM AND SPACE HEATERS**

| DISTANCE FROM COMBUSTIBLE CONSTRUCTION<br>(Inches) |                        |                                |
|--|------------------------|--------------------------------|
| Type   | Jackets, Sides<br>Rear | Projecting Flue<br>Box or Hood |
| 1. Circulating Space Heaters                       | 6                      | 2                              |
| 2. Recessed Wall Heaters                           | Flush                  | —                              |
| 3. Gas Steam Radiators                             | 6                      | 2                              |
| 4. Radiant Heaters                                 | 6                      | 2                              |
| 5. Unit Heaters                                    | 6                      | 6                              |

**Space Heating  
Furnaces and  
Boilers  
(Cont'd.)**

The furnace shall be so placed that a door cannot be nearer than twelve inches (12") to any portion of the register of the furnace.

(i) **Ducts. 1. Length and slope.** For gravity systems no leader heat pipes shall be over twenty feet (20') in length measured horizontally, except where a booster fan is installed, when the length shall not exceed forty feet (40'). All heat pipes under first-floor joists shall have a uniform rise of at least one inch (1") per lineal foot of horizontal run.

**2. Size.** Warm-air pipes and appurtenances serving first-floor rooms shall have a minimum cross-sectional area in square inches of not less than the cubic-foot capacity of the room or rooms in which registers are located, divided by 40, provided that no leader pipe shall have a net area of less than fifty square inches (50 sq. in.). Risers and appurtenances serving floors above the first floor shall have a net area of not less than two-thirds that required to serve the first floor.

**3. Material.** Ducts shall be of incombustible material equivalent in structural strength, durability, and thickness to the materials set forth in Table No. 51-E. Wire glass may be used for inspection windows in ducts.

Ducts may be of independent construction or may be formed by parts of the building structure if they conform to the requirements of this Section. Duct walls may be of lath and plaster as approved for one-hour fire-resistive construction.

**4. Registers.** Registers shall be located in or near the wall of the room nearest the furnace. No register shall be located in outside walls unless the weather side is covered with air-cell asbestos paper.

Where double registers are supplied by one leader pipe, each register shall have a capacity of not less than two-thirds the area of the leader pipe.

**5. Construction and installation.** Ninety-degree bends in round pipe shall be made by not less than four-piece elbows. Sixty-degree bends shall be made by means of not less than three-piece elbows.

All warm-air pipes and fittings, cold-air or circulating pipes, ducts, boxes and fittings shall be made of materials set forth in Table No. 51-E, and shall be covered with two thicknesses of asbestos paper weighing at least eight pounds to one hundred square feet (100 sq. ft.), or with air-cell asbestos insulation, or shall be double walled, with one-fourth-inch ( $\frac{1}{4}$ " ) space between the inner and outer walls.

In addition, leader heat pipes under the first floor shall be kept at least three inches (3") from any combustible material or shall be protected with an asbestos shield and a one-inch (1") air space. Air-cell asbestos paper not less than one-fourth inch ( $\frac{1}{4}$ " ) in thickness shall be securely cemented around all leader heat pipes.

6. **Support.** All riser pipes shall be held in place by means of metal strips securely fastened to the pipe and shall in no case be held in place by nailing diagonally through the corners of such pipe. No joint shall depend wholly upon solder to make it tight. All leader pipes shall be securely fastened in place by means of wires or metal strips.

7. **Branch or Y-runs.** In the installation of Y-runs or branch runs, the cross-sectional area of the warm-air pipe at the furnace shall equal in square inches the cubic con-

**Space Heating  
Furnaces and  
Boilers  
(Cont'd.)**

**TABLE NO. 51-D—MINIMUM CLEARANCES FOR  
ROOM AND SPACE HEATERS BURNING SOLID  
AND LIQUID FUEL**

| DISTANCE FROM COMBUSTIBLE CONSTRUCTION<br>(Inches) |                        |
|--|------------------------|
| Type   | Jackets, Sides<br>Rear |
| 1. Circulating Space Heaters                       | 12                     |
| 2. Recessed Wall Heaters                           | Flush                  |
| 3. Radiant Heaters                                 | 36                     |
| For reduced clearances see Table No. 51-A.         |                        |

**TABLE NO. 51-E—THICKNESS OF METAL  
FOR AIR DUCTS**

| ROUND DUCTS<br>Diameter<br>(Inches) | RECTANGULAR<br>DUCTS<br>Maximum Side<br>(Inches) | GALVANIZED<br>IRON<br>Minimum<br>Thickness<br>U. S. Gauge | ALUMINUM<br>Minimum<br>Thickness<br>B&S Gauge | TIN<br>Minimum<br>Thickness<br>Gauge |
|-------------------------------------|--|---|---|--------------------------------------|
| Up to 18                            | Up to 12   | 26  | 24  | ICL                                  |
| 19 to 30                            | 13 to 30   | 24  | 22  |                                      |
| 31 to 45                            | 31 to 60   | 22  | 20  |                                      |
| 46 to 60                            | 61 to 90   | 20  | 18  |                                      |
| 61 & above                          | 91 & above                                       | 18  | 16  |                                      |



**Space Heating Furnaces and Boilers (Cont'd.)** tents of all the rooms served by such warm-air pipe divided by 40.

Sizes of branch runs shall be determined in the same manner on the basis of the room or rooms served. Branches from trunk lines shall be taken off in a generally horizontal plane at an angle not more than 45 degrees from the line of the pipe. Fifteen-degree Y-branches may be permitted in forced-draft systems. Riser pipes shall not be taken off the top of the first-floor registered boxes.

8. **Clearance between joists or studs.** Where warm-air pipes and appurtenances are to be installed in a building, the joists and studs shall be so arranged as to provide not less than fourteen inches (14") clear space in continuous horizontal runs and vertical risers from the furnace to the register served.

9. **Air filters.** Air filters shall be of a type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when attacked by flames. Liquid-adhesive coatings used on filters shall have a flash point of 350 degrees Fahrenheit, Cleveland open cup tester, or higher.

(j) **Boiler Piping.** The method of connecting the flow and return pipes on steam and hot-water boilers shall facilitate a rapid circulation of steam or water.

Steam pipes and hot-water heating pipes shall be installed with a clearance of at least one inch (1") to all combustible construction or material, except that at the points where pipes carrying steam or hot water at not over 15 pounds gauge pressure emerge from a floor, wall, or ceiling, the clearance at the opening through the finish floor boards or wall ceiling boards may be less than one inch (1") but not less than one-half inch ( $\frac{1}{2}$ "). Each such opening shall be covered with a plate of noncombustible material.

Such pipes passing through stock shelving shall be covered with not less than one inch (1") of approved insulation.

Wooden boxes or casings enclosing uninsulated steam or hot-water heating pipes, or wooden covers to recesses in walls in which such uninsulated pipes are placed, shall be lined with metal or asbestos mill board.

Where the temperature of the boiler piping does not exceed 160 degrees Fahrenheit the provisions of this Subsection shall not apply.

Coverings or insulation used on steam or hot-water pipes shall be of incombustible material.

**Room or Space Heaters**

**Sec. 5106. (a) General.** The equipment covered by this Section shall be installed according to the provisions of this Chapter. Such equipment shall not be altered nor shall the fuel input be increased in excess of the manufacturer's rated input. Defective material or parts shall be replaced in such a manner as not to invalidate the approvals as specified in Section 5101 (b).

(b) **Labeling.** All equipment covered by this Section shall be labeled as specified in Section 5105 (b) for furnaces and boilers.

(c) **Venting.** Heating appliances covered by this Section shall be connected to a flue vent or chimney complying with Chapter 37 of this Code.

**Room or  
Space  
Heaters  
(Cont'd.)**

**EXCEPTION:** Gas heating appliances other than those in Group D, H, and I occupancies need not be vented if designed without a vent collar and so listed and approved for use without a flue vent or chimney by a nationally recognized testing laboratory.

(d) **Location.** Room heaters shall be placed so as not to cause a hazard to walls, floors, and doors. Room heaters designed and marked "for use in incombustible fire-resistive fireplace only," shall not be installed elsewhere.

(e) **Clearances.** 1. **Gas-fired approved room and space heaters.** Approved room and space heaters shall be installed with clearances from combustible construction as set forth in Table No. 51-C.

**CIRCULATING SPACE HEATER,** a space heater designed to convert the energy in fuel gas to convected heat, or radiant heat and convected heat, by the circulation of the products of combustion and room air, or room air only.

**Definitions**

**RECESSED WALL HEATER,** a space heater designed for installation within a wall or partition and approved for such use.

**STEAM RADIATOR,** a space heater in which all the energy in the fuel gas (with the exception of that lost from the flue by radiation or convection from the combustion chamber) is transmitted to the surrounding atmosphere through the medium of steam or hot water generated within the appliance. In this definition, the combustion chamber is that part of the appliance in which combustion of the gas takes place and does not include the flue passages.

**RADIANT HEATER,** a space heater designed primarily to convert the energy in fuel gas to radiant heat.

**UNIT HEATER—LOW STATIC PRESSURE TYPE,** a self-contained, automatically controlled, vented, gas-burning appliance, limited to the heating of nonresidential space in which it is installed. Such appliances shall have integral means for circulation of air, normally by a propeller fan or fans, and may be equipped with louvres or face extensions made in accordance with the manufacturer's approved specifications.

**UNIT HEATER—HIGH STATIC PRESSURE TYPE,** a self-contained, automatically controlled, vented, gas-burning appliance, limited to the heating of nonresidential space. These appliances have integral means for circulation of air against two-tenths-inch (0.2") or greater static pressure and are designed for installation in the space to be heated unless they are equipped with provisions for attaching both inlet and outlet air ducts.

**Room or  
Space  
Heaters  
(Cont'd.)**

2. **Untested room and space heaters.** Untested gas-fired room or space heaters shall be installed with clearances from combustible construction not less than the following:

**CIRCULATING TYPE**, room heaters having an outer jacket surrounding the combustion chamber, arranged with openings at top and bottom so that air circulates between the inner and outer jacket, and without openings in the outer jacket to permit direct radiation. Such heaters shall have clearances at sides and rear of not less than twelve inches (12").

**RADIANT TYPE**, room heaters other than those described above as of circulating type. Such heaters shall have clearances at sides and rear of not less than eighteen inches (18"); except that heaters which make use of metal, asbestos, or ceramic material to direct radiation to the front of the appliance, shall have a clearance of thirty-six inches (36") in front, and if constructed with a double back of metal or ceramic may be installed with a clearance of eighteen inches (18") at sides and twelve inches (12") at rear.

3. **All other types.** All other room or space heaters shall have a clearance at side and rear of not less than eighteen inches (18") with the floor protected in an approved manner. Reduced clearances shall be as set forth in Table No. 51-A.

(f) **Clearances—Heaters Burning Solid and Liquid Fuel.** Clearances shall be as set forth in Table No. 51-D.

**CIRCULATING SPACE HEATER**, a space heater having an outer jacket surrounding the casing around the combustion chamber, arranged with openings at top and bottom so that air circulates between the inner casing and the outer jacket. Space heaters with openings in the outer jacket to permit some direct radiation from the inner casing shall be classed as radiating type.

**RECESSED WALL HEATER**, a space heater designed for installation within a wall or partition and approved for such use.

**RADIANT HEATER**, a space heater designed primarily to convert the energy in fuel to radiant heat.

(g) **Support.** Suspended-type unit heaters shall be safely and adequately supported with due consideration given to their weight and vibration characteristics.

(h) **Mounting.** Except as otherwise provided, floor-mounted heating appliances shall be mounted on the ground, or on floors of Type I construction or fire-resistive construction with incombustible flooring and surface finish, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall in all cases extend not less than six inches (6") beyond the appliance on all sides, and where solid fuel is used shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

Floor-mounted heating appliances which are approved specifically for installation on a combustible floor may be mounted in accordance with the conditions of such approval.

Floor-mounted heating appliances which are set on legs which provide not less than four inches (4") open space under the base of the appliance may be mounted on floors other than as specified in this Subsection, provided the floor under the appliances is protected with sheet metal of not less than 24 U. S. gauge or by other approved incombustible material. Where solid fuel is used the protection shall extend not less than eighteen inches (18") beyond the appliance at the front or side where ashes are removed. With radiating-type space heaters burning gas, which make use of metal, asbestos, or ceramic material to direct radiation to the front of the device, the floor protection shall extend out at the front not less than thirty-six inches (36") when the heater is not of a type approved for installation on a combustible floor.

Floor-mounted heating appliances which are set on legs which provide not less than eighteen inches (18") open space under the base of the appliance, or which have no burners and no portion of any firebox within eighteen inches (18") of the floor, may be mounted on floors other than as specified in this Subsection, without special floor protection, provided there is at least one sheet-metal baffle between the burners or firebox and the floor.

Floor-mounted heating appliances may be mounted on floors other than as specified in this Subsection, provided the floor under the appliance is protected with hollow masonry not less than four inches (4") in thickness, covered with sheet metal of not less than 24 U. S. gauge. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air from side to side through the masonry. Where solid fuel is used the floor for eighteen inches (18") beyond the front of the appliance or side where ashes are removed shall be protected with sheet metal of not less than 24 U. S. gauge, or with protection equivalent thereto.

**Sec. 5107. (a) Prohibited Locations.** No water heater shall be installed in any room used or designed to be used for sleeping purposes, bathroom, clothes closet, or under any stairway or landing, or in any confined space with access only to the above locations.

**(b) Water Heaters Installed in Garages.** Water heaters installed in garages shall be adequately guarded against mechanical injury and from coming in contact with combustible material.

**(c) Water-Heater Enclosures or Recesses.** An enclosure or recess used to house a water heater shall be of such size that the heater is readily accessible for adjustment, service, or replacement and provides adequate clearance as specified in Subsection (e). When water heaters are installed in attics, access to such space shall comply with the provisions of Section 5103 (c) of this Chapter. Ceiling construction shall

**Room or  
Space  
Heaters  
(Cont'd.)**

**Water  
Heaters**

**Water  
Heaters  
(Cont'd.)**

be maintained where any heater would otherwise project partially into an attic space.

(d) **Air for Combustion.** Air for combustion shall be supplied as specified in Section 5102.

(e) **Clearances.** Water heaters may be positioned in relation to combustible construction with minimum clearance as follows:

1. Approved gas-fired circulating tank, instantaneous, and uninsulated underfired types.... 6"
2. Approved gas underfired, insulated automatic storage types ..... 2"
3. Approved gas underfired, insulated automatic storage types (with one or more flat sides) ..... Flush
4. Untested gas-fired or types burning solid or liquid fuel ..... 12"

In no case shall the clearance be reduced so as to interfere with the requirements for accessibility and combustion air.

Approved liquid-fuel-burning water heaters may be placed in relation to combustible construction as specified under conditions of approval and listings.

Reduced clearances shall be as set forth in Table No. 51-A.

(f) **Relief Valves.** All water-heating appliances which are installed in a closed system of water piping, or any water heater connected to a separate storage tank and having valves between said heater and tank, shall be provided with a water-pressure relief valve set at a pressure of not more than fifty (50) pounds per square inch gauge pressure above the pressure of the water supply.

Every required pressure relief valve shall be an approved automatic type with drain. The pressure relief valve shall be installed in the cold-water supply pipe between the pressure regulator or check valve and each heater or tank. If a pressure relief valve is located inside the building, a drain pipe shall extend therefrom to the outside of the building, with the end of the pipe not over two feet (2') above the ground and pointing downward. Such drain may terminate at other approved locations. Every relief valve shall be readily accessible. No shut-off valve of any kind shall be installed between the pressure relief valve and the tank it serves.

(g) **Reconditioned Water Heaters.** No parts used to repair or recondition gas water heaters shall differ in type, make, or construction under which such gas water heater was originally approved. Defective parts or material must be replaced in kind in order to validate the conditions of approval as specified in this Chapter.

(h) **Venting.** Water heaters shall be connected to a vent and vent connection meeting the requirements of Chapter 37.

(i) **Tubing Connectors.** Tubing connectors shall comply with Section 5101 (f).

**Sec. 5108. (a) General.** Incinerators for the reduction of refuse, garbage, or other waste materials shall be installed in accordance with the provisions of this Section. Materials and structural design shall meet the requirements of Part VI of this Code.

**(b) Small Domestic Type.** Incinerators of small uninsulated domestic-type installed indoors shall be constructed, mounted, installed, and vented according to the applicable requirements for room heaters burning solid or liquid fuel as specified in Section 5106, except that mounting shall be on an incombustible and fire-resistive floor, and minimum clearances to combustible material shall be thirty-six inches (36") above, forty-eight inches (48") in front, and thirty-six inches (36") in back and at sides. The requirements of this Subsection shall also apply to incinerators installed as a part of other appliances.

Incinerators of small domestic type, or those that are a part of another appliance, that have been tested and approved by a nationally recognized testing agency and approved for installation on a combustible floor or with lesser clearances shall be installed in accordance with the conditions of such approval and shall be connected to a Type "A" flue or vent complying with the requirements of Chapter 37.

Outdoor incinerators of small domestic type shall be constructed and located to meet the approval of the Chief of the Fire Department.

**(c) Incinerators Using the Flue as a Refuse Chute.** Incinerators in which no fuel other than normal refuse, except a gas flame or similar means to accomplish ignition, is used for combustion, and in which the chute and smoke flue are identical, shall have the enclosing walls of the combustion chamber constructed of clay or shale brickwork not less than four inches (4") thick when there is a horizontal grate area of not more than nine square feet (9 sq. ft.) and not less than eight inches (8") thick when there is a horizontal grate area exceeding nine square feet (9 sq. ft.) and, in each case, a lining of firebrick not less than four inches (4") thick, with an air space, in the case of the thicker wall, between the clay or shale brick and the firebrick sufficient to provide for expansion and contraction.

The combined chute and flue shall be constructed as required for incinerator chimneys in Section 3703 (e). Such chute and flue shall be constructed straight and plumb, and finished smooth on the inside. All flues shall terminate in a substantially constructed spark arrester having a mesh not exceeding three-fourths inch ( $\frac{3}{4}$ ").

Firebrick shall be laid in fire-clay mortar.

Service openings into the chute shall be equipped with approved self-closing hoppers so constructed that the opening is closed off while the hopper is being charged and that no part will project into the chute or flue. The area of the service opening shall not exceed one-third of the area of the chute or flue.

**Incinerators  
(Cont'd.)**

(d) **Commercial and Industrial Type Incinerators.** Commercial and industrial type incinerators designed to burn not more than 250 pounds of refuse per hour and having a horizontal grate area not exceeding nine square feet (9 sq. ft.) shall have the enclosing walls of the combustion chamber constructed of clay or shale brick not less than eight inches (8") thick with a lining of firebrick not less than four inches (4") thick, provided that the outer four inches (4") of clay or shale brickwork may be replaced by a steel plate casing not less than three-sixteenths inch (3/16") in thickness.

Commercial and industrial type incinerators of a size designed to burn more than 250 pounds of refuse per hour and having a grate area exceeding nine square feet (9 sq. ft.) shall have the enclosing walls of the combustion chamber constructed of clay or shale brick not less than eight inches (8") thick with a lining of firebrick not less than eight inches (8") thick, provided that the outer four inches (4") of clay or shale brickwork may be replaced by a steel plate casing not less than three-sixteenths inch (3/16") in thickness.

Combustion chamber walls shall be strongly braced and stayed with structural steel shapes, and the firebrick linings shall be laid in fire-clay mortar.

Incinerators with their waste material bins or containers shall be located in a room or compartment used for no other purpose, or in a room devoted exclusively to boilers and heating plant. In either case such room shall be separated from the rest of the building by two-hour fire-resistive walls, floors, and ceilings, with all openings equipped with single fire doors of a type required for Class "A" openings.

The flue connections or breechings from the combustion chamber shall be constructed of not lighter than 16 U. S. gauge metal when they do not exceed twelve inches (12") in diameter or greatest dimension and of 12 U. S. gauge metal when they exceed twelve inches (12") in diameter or greatest dimension. In addition they shall be lined with firebrick, laid in fire-clay mortar, not less than two and one-half inches (2½") thick when they are between twelve inches (12") and eighteen inches (18") in diameter or greatest dimension, and not less than four and one-half inches (4½") thick when they are larger. If they lead into and combine with flue connections or breechings from other appliances, such other connections or breechings shall also be lined as required for direct flue connections, unless the cross-section area of the connection into which they lead is at least four times the area of the incinerator connection.

The clearance to woodwork or other combustible material or construction, on all sides of flue connections or breechings, shall be not less than thirty-six inches (36") provided that clearances may be modified as set forth in Table No. 51-A.

Refuse chutes shall not feed directly to the combustion chamber, but shall discharge into a room or bin enclosed and

separated from the incinerator room by floors, ceilings, and walls of not less than two-hour fire-resistive construction. The opening through which material is transferred from such room or bin to the incinerator room shall be equipped with a fire door of a type required for Class "A" openings.

**Incinerators  
(Cont'd.)**

Refuse chutes shall rest on substantial incombustible foundations. The enclosing walls of such chutes shall consist of clay or shale brickwork not less than eight inches (8") thick or of reinforced concrete not less than six inches (6") thick. Such chutes shall extend to and not less than four feet (4') above the roof and shall be covered by a metal skylight glazed with single thick plain glass.

Service openings for chutes shall be located in separate rooms or compartments enclosed in walls or partitions, floors, and ceilings having a fire-resistance rating of not less than one hour. Such openings shall be equipped with fire doors or other approved devices of a type required for Class "B" openings.

(e) **Other Types.** Incinerators of types other than those regulated above shall be constructed and installed in accordance with the requirements of Section 5108 (d), except for special large-capacity incinerators and refuse burners used in connection with sawmills and woodworking plants and except for other approved types which incinerators shall meet the approval of the Chief of the Fire Department.

**Sec. 5109. (a) Clearances.** Appliances so constructed that the burners or heating elements are not shielded by metal or other approved insulating material shall have a minimum clearance of twelve inches (12") to any combustible material above the burner or heating element level. Appliances approved for installation at lesser distances from combustible material may be installed with clearances for which they are approved. Appliances having open flames shall not be installed where the vertical clearance to combustible construction is less than thirty-six inches (36"). A two-foot (2') vertical clearance over open flame gas appliances is permitted if the underside of the combustible construction exposed to flame is protected with a minimum of one-fourth-inch ( $\frac{1}{4}$ ") asbestos millboard covered with 28 U. S. gauge or heavier sheet-metal covering, and the projection extends a minimum of nine inches (9") beyond the outer dimensions of the appliance. Reduced clearances shall be as set forth in Table No. 51-A.

**Miscellaneous  
Domestic  
Appliances**

(b) **Ranges and Hot Plates.** Ranges or hot plates shall not be installed in rooms intended to be used for sleeping purposes. There shall be installed in the wall or ceiling, approximately over the cooking facilities, a ventilating opening with a minimum area of eight inches by six inches (8" x 6"), connected by an incombustible ventilating duct free to the outside of the building. The ventilating duct for each kitchen shall have a minimum cross-sectional area of twenty-eight square inches (28 sq. in.). An approved forced-



**Miscellaneous  
Domestic  
Appliances  
(Cont'd.)**

draft system of ventilation may be substituted for the natural-draft ventilating system.

Combination-type gas and solid-fuel ranges and trash-burner ranges must be vented to a Type "A" chimney constructed in accordance with the provisions of this Chapter for use by trash burners. Solid-top-type gas ranges and built-in gas circulator-type ranges shall be vented to an approved Type "B" gas vent or Type "A" chimney. Gas ranges having a griddle and open-type top burners are not classed as solid-top ranges.

(c) **Domestic Clothes Dryers.** Clothes dryers shall not be installed in bathrooms or rooms used for sleeping purposes. Venting of gravity-type clothes dryers shall conform to the vent requirements of Chapter 37.

Where adequate room ventilation is not provided, blower-type clothes dryers shall be exhausted in such a manner as to insure that the moisture is carried to the outside air. In no case shall the exhaust terminate beneath the building or in the attic area.

**Commercial  
Food  
Preparation  
Equipment**

**Sec. 5110. (a) General.** The provisions of this Subsection shall apply to ranges, broilers, ovens, and other miscellaneous appliances of a type generally used in hotel, restaurant, and institutional kitchens. Such appliances shall be installed level on a firm foundation. Rooms containing commercial food preparation equipment shall be provided with sufficient openings to the outside air to prevent accumulation of hot air over appliances and to prevent lowering of atmospheric pressure due to air exhausted by mechanical means and shall in no case provide less than four air changes per hour.

(b) **Mounting of Appliances.** Ranges, broilers, and ovens may be installed with their bases or legs on unprotected combustible floors if they are approved for such installation.

Ranges, broilers, and ovens not approved for installation directly on unprotected combustible floors shall be mounted on floors of concrete or other fire-resistive construction, which shall have no combustible material on the underside thereof, and which shall extend not less than 12 inches (12") beyond the appliance on all sides and, where solid fuel is used, shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

**EXCEPTIONS:** 1. Appliances which are set on legs which provide not less than eighteen inches (18") open space under the base of the appliance, or which have no burners and no portion of any oven or broiler within eighteen inches (18") of the floor, may be mounted on combustible floors, provided there is at least one sheet-metal baffle between the burners and the floor.

2. Appliances which are set on legs which provide not less than eight inches (8") open space under the base of the appliance, may be mounted on combustible floors, pro-

**Commercial  
Food  
Preparation  
Equipment  
(Cont'd.)**

vided the floor under the appliance is protected with not less than one-fourth-inch ( $\frac{1}{4}$ " ) asbestos millboard covered with sheet metal of not less than 24 U. S. gauge. The above specified floor protection shall extend not less than six inches (6") beyond the appliance on all sides, and where solid fuel is used shall extend not less than eighteen inches (18") at the front or side where ashes are removed.

3. Appliances which are set on legs which provide not less than four inches (4") open space under the base of the appliance, may be mounted on combustible floors, provided the floor under the appliance is protected with hollow masonry not less than four inches (4") in thickness, covered with sheet metal of not less than 24 U. S. gauge. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air through the masonry. Where solid fuel is used, the floor for eighteen inches (18") beyond the front of the appliance or side where ashes are removed shall be protected with not less than one-fourth-inch ( $\frac{1}{4}$ " ) asbestos millboard covered with sheet metal of not less than 24 U. S. gauge, or with protection equivalent thereto.

4. Appliances may be mounted on combustible floors, provided the floor under the appliance is protected by two courses of four-inch (4") hollow clay tile or equivalent, with courses laid at right angles and with ends unsealed and joints matched in such a way as to provide a free circulation of air through such masonry courses, and covered with steel plate not less than three-sixteenths inch ( $\frac{3}{16}$ " ) in thickness. Where solid fuel is used, the floor for eighteen inches (18") beyond the front of the appliance or side where ashes are removed shall be protected with not less than one-fourth-inch ( $\frac{1}{4}$ " ) asbestos millboard covered with sheet metal of not less than 24 U. S. gauge, or with protection equivalent thereto.

(c) **Clearances for Approved Appliances.** Ranges, broilers, and ovens shall be installed to provide a clearance to walls of combustible material not less than that specified in the conditions of approval. Approved gas-fired appliances shall be installed not less than six inches (6") from combustible construction except that at least a two-inch (2") clearance shall be maintained between the flue box or draft hood and combustible construction. Reduced clearances shall be as set forth in Table No. 51-A.

(d) **Clearances for Unapproved Appliances.** Ranges, broilers, and ovens not approved for specific clearances shall be installed to provide a clearance to walls of combustible construction of not less than eighteen inches (18"). Reduced clearances shall be as set forth in Table No. 51-A.

(e) **Wall Protection Above Cooking Top.** Where a wall of combustible construction adjacent to the cooking top of an appliance is not shielded by a high shelf or ventilating system, the wall shall be protected by sheet metal of not less

**Commercial  
Food  
Preparation  
Equipment  
(Cont'd.)**

than 28 U. S. gauge over one-fourth-inch ( $\frac{1}{4}$ " ) asbestos millboard extending at least twenty-four inches (24") above the surface of the cooking top.

(f) **Hoods. 1. When required.** Restaurant-type ranges, fry kettles, candy kettles, cruller furnaces, and appliances for the frying of bakery or confectionery products, shall be provided with ventilating hoods and ducts to the outside air to take off the smoke, gases, and vapors, unless such appliances are of the enclosed type and are vented in an approved manner.

**2. Location.** Such hoods shall not be raised more than seven feet (7') above the floor. Hoods shall be of sufficient depth to extend at least six inches (6") beyond all sides of units served.

**3. Construction.** Such hoods and their ducts shall be constructed of incombustible materials with tight unsoldered joints and if of metal shall be of not less than 24 U. S. gauge copper, galvanized iron, or other equivalent corrosion-resistant ferrous metal. Hood ducts shall not be connected with any other ventilating system, but connect into flues or stacks used for the same purpose and conforming to the requirements for smoke flues. The hood shall have a grease trough extending around the perimeter, draining into a grease container outside the hood. A sufficient number of cleanout openings shall be provided in horizontal runs of every duct to permit cleaning of all portions of the interior of such areas where grease is likely to condense and trap.

**4. Grease extraction.** Approved grease filters or grease baffles shall be installed at the inlet of the exhaust system.

**5. Exhaust capacity.** Exhaust-duct systems shall be so designed as to create a conveying air velocity of not less than fifteen hundred feet (1500') and not more than twenty-two hundred feet (2200') per minute.

**6. Clearances.** Such hoods and their ducts shall be installed to provide a clearance to woodwork or other combustible material whether plastered or unplastered of not less than eighteen inches (18"). Reduced clearances shall be as set forth in Table No. 51-A. The ducts shall not pass through combustible walls or partitions unless they are protected at the point of passage as specified for smoke pipes in Section 3709.

**7. Gas-appliance vents.** Vents for this type of equipment may be of Type C and shall be sized as specified in Section 3706 (c), Paragraph 5.

Where gravity-type hoods are used, vents from the appliance shall extend a minimum of six inches (6") above the lower perimeter of the hood and shall be opened to allow flue gases to mix with cooler air before entering the ventilating system.

Where forced-draft-type hoods or systems are used, vents

from appliances shall be installed so that the flue gases will mix with cooler air before entering the ventilating system.

**Commercial  
Food  
Preparation  
Equipment  
(Cont'd.)**

(g) **Gas Counter Appliances.** 1. **Vertical clearance.** A vertical distance of not less than forty-eight inches (48") shall be provided between the top of all commercial hot plates and griddles and combustible construction.

2. **Approved appliances.** Approved gas counter appliances such as commercial hot plates and griddles, food and dish warmers, coffee brewers and urns, waffle bakers, and hot-water immersion sterilizers, when installed on combustible surfaces shall be set on their own bases or legs, and shall be installed with a minimum horizontal clearance of six inches (6") from combustible construction.

3. **Untested appliances.** Untested commercial hot plates and griddles shall be installed with a horizontal clearance from combustible construction of not less than eighteen inches (18"). Untested gas counter appliances such as coffee brewers and urns, waffle bakers, and hot-water immersion sterilizers shall be installed with a horizontal clearance from combustible construction of not less than twelve inches (12"). Gas counter appliances may be installed with lesser clearances than specified above where the combustible construction is protected as set forth in Table No. 51-A. Untested food and dish warmers shall be installed with a horizontal clearance from combustible construction of not less than six inches (6"). Combustible surfaces under untested gas counter appliances shall be protected in an approved manner.

(h) **Steam and Hot Food Tables.** Burners of gas-fired steam tables shall be located at least twelve inches (12") above any wood floor with a 24 U. S. gauge sheet-metal baffle located between burners and floor. Pan containing water shall be separated by at least one inch (1") from metal body of steam table. Sufficient openings of one square inch (1 sq. in.) to 1000 B.t.u. shall be provided in upper section of body of steam table to permit escape of products of combustion, wherever steam table is fully enclosed, such as where sliding doors are fitted to body of unit. Baffle or shelving shall be perforated with openings of one square inch (1 sq. in.) per 1000 B.t.u. for air to support combustion. Bodies of hot food tables shall be insulated with at least one-fourth inch ( $\frac{1}{4}$ ") of approved insulation.

(i) **Dishwashers.** Gas-fired dishwashers having burners within eight inches (8") of any wood floor or combustible base shall be mounted on 24 U. S. gauge sheet metal insulated with one-fourth-inch ( $\frac{1}{4}$ ") asbestos millboard. The back and ends shall have at least six inches (6") clearance from combustible partitions or walls, providing the walls or partitions are covered with 24 U. S. gauge sheet metal. Combustible shelving under dishtable shall be at least eighteen inches (18") away from ends of unit. Immersion-type dishwashers located in basements or subfloor rooms shall have hoods installed not less than six feet six inches (6'6") above the floor and in no case shall the dishwasher hood

area be smaller than the top of the dishwasher. Tank-type dishwashers located in basements or subfloor rooms shall be provided with duct openings and these shall be connected to a ventilating system.

(j) **Portable Gas Baking and Roasting Ovens.** Approved portable gas baking and roasting ovens shall be installed at least six inches (6") from combustible construction, except that at least a two-inch (2") clearance shall be maintained between the flue box or draft hood and combustible construction. Untested portable baking and roasting ovens shall be installed with clearances to combustible construction of not less than eighteen inches (18"). Reduced clearances shall be as set forth in Table No. 51-A.

**Industrial  
Heating  
Equipment**

**Sec. 5111. (a) Construction.** Industrial heating equipment shall be substantially constructed in a workmanlike manner.

(b) **Installation, Mounting, and Clearances.** Appliances shall be installed, mounted, and have clearances so as not to raise the temperature of nearby combustible materials to temperatures exceeding 90 degrees Fahrenheit plus room temperature. The manufacturer or installer, or both, shall supply the Building Official with the necessary information regarding installation, mounting, and clearances to enable the above conditions to be met.

(c) **Venting.** Industrial heating equipment shall be connected to a vent, flue, or chimney complying with the provisions of Chapter 37, except that the sizes of the vent flues or chimneys for commercial and industrial type heating equipment shall be determined in accordance with the manufacturer's specifications.

(d) **Ventilation.** Rooms containing industrial heating equipment shall be provided with means of ventilation adequate to prevent excessive accumulation of hot air over or near the appliance.

**Heating and  
Power Boilers**

**Sec. 5112. Construction.** Heating boilers shall be constructed in accordance with nationally recognized standards.

**Fuel Supply  
and Storage  
Facilities**

**Sec. 5113. (a) Gas Piping.** Gas piping supplying appliances, together with fittings, valves, and other appurtenances, shall be constructed and installed in accordance with nationally recognized safety standards.

(b) **Oil Burners and Oil Supply.** Oil-burning equipment, which shall be held to mean oil burners, piping, pumps, controls, and other accessories, shall be constructed and installed in accordance with the requirements set forth in U.B.C. Standard No. 9-1.

No fuel-oil supply tank shall be permitted attached to or made an integral part of an appliance unless it is included within the scope of approval of the appliance as specified in Section 5101 (b). Every tank not attached to or consti-

tuting an integral part of an appliance shall be constructed and installed according to the requirements set forth in U.B.C. Standard No. 9-1.

**Fuel Supply  
and Storage  
Facilities  
(Cont'd.)**

(c) **Liquefied Petroleum Gases.** Fuel containers, piping, fittings, valves, and accessories used in supplying appliances with liquefied petroleum gases shall be constructed and installed in accordance with the requirements set forth in U.B.C. Standard No. 51-1.

Heat-producing appliances using liquefied petroleum gas or liquefied gas-air mixtures equipped with pilots for automatic ignition, except range-top burners, shall be equipped with an approved automatic pilot light controlled shut-off valve that will automatically shut off gas to both burner or burners and pilot light when the pilot light is extinguished.

## UNIFORM BUILDING CODE

### HOW TO USE THE UNIFORM BUILDING CODE

#### How to Use the Uniform Building Code

The following procedures will be helpful in the use of the Uniform Building Code:

1. Determine the **Occupancy Group** in which the use of the building most nearly fits—the “01” sections of Chapters 6-15 inclusive. Where portions of the building are used for different purposes, walls of specific fire-resistive ratings may be required. Section 503.

2. Determine the **Type of Construction** which it is desired to use—Chapters 17-22 inclusive.

3. Check the location of the site as to local **Fire Zone** from the city hall and check limitations in that Fire Zone—Chapter 16.

4. Check **Area Limitations** for the particular Occupancy Group and Type of Construction—Table No. 5-C. If allowable area is not adequate, check **Allowable Area Increases**, Section 506, for possible increase of area, or change Type of Construction to one allowing greater areas.

5. Check **Number of Stories**, Table No. 5-D, for allowable number of stories for the particular Occupancy Group and Type of Construction. If allowable number of stories is not adequate, check **Maximum Height of Buildings**, Section 507, for possible increase, or change Type of Construction to one allowing a greater number of stories.

6. Check **Detailed Occupancy Requirements** in the appropriate chapter, Chapters 6-15.

7. Check **Detailed Construction Requirements** in the appropriate chapter, Chapters 17-22.

8. **Location on Property** in relation to side and rear property lines and other buildings located on the same property should be guided by Section 504 and Table No. 5-A. This will help determine wall and opening requirements.

9. **Design** and other **Detailed Requirements** are found in Chapters 23-51.

10. In case of doubt, question your Building Official.

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